STORE MODE/DATA MEMORY STOCK

The STORE mode STOREs voices created in the Edit mode and effects programmed in the Function mode in memory.

6-1 3 Varieties of the STORE Function

3 Types of Memory

The DX1 has two types of memory function, for voice data in the 2-channel VOICE MEMORY, and PERFORMANCE MEMORY. Further, for each of these, the following three different types of memory are provided.

(1) INTERNAL MEMORY
Data is preserved inside the DX1: RAM (VOICE MEMORY=8 voices X 4 banks X 2 channels; PERFORMANCE MEMORY=8 performances X 8 banks).

(2) CARTRIDGE
Internal memory expansion, external data storage: ROM (VOICE MEMORY=32 voices X 2 sides X 2 cartridges; PERFORMANCE MEMORY=64 performances). RAM (VOICE MEMORY=32 voices X 2 cartridges; PERFORMANCE MEMORY=64 performances).

(3) BUFFER
Data is read into the buffer from the Cartridge or internal memory for data editing and performance: RAM ((VOICE MEMORY (Voice Edit Buffer)=2 channels X 1 voice; PERFORMANCE MEMORY (Performance Edit Buffer)=1 performance)).

* The use of these three types of memory affords a wide range of operating possiblities. The STORE mode allows you to exchange data among the 2-channel VOICE MEMORY and PERFORMANCE MEMORY in virtually any way required.

3 Varieties of the STORE Function

* The STORE mode is engaged by pressing the STORE button on the right side of the control panel (Fig. 83). The STORE mode takes precedence over all other modes, so the STORE mode can be switched to at any time just by pressing the STORE button. Further, when the STORE mode is disengaged, the mode engaged prior to entering the STORE mode will be returned to automatically.
* To make the most effective use of this capability, we recommend that instead of preserving data with the STORE mode after the voice creation process has been fully completed, you should enter data at several stages throughout the voice creation process. This eliminates the possiblity of losing all the data through an accidental misoperation.
* The STORE mode has three options, STORE ALL, STORE VOICE, and STORE PERFORMANCE, and these are selected via the DATA ENTRY NO switch. Using these three functions separately and together, it becomes possible to interchange data freely.

Fig. 82a. Voice Memory Data Transmission Channels

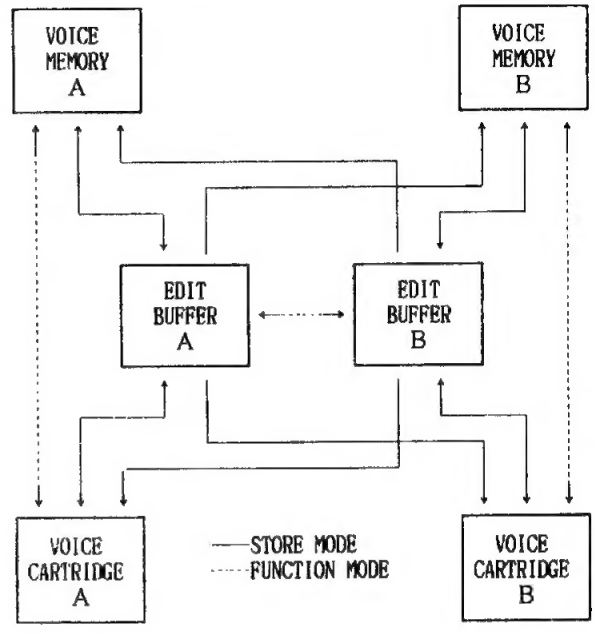


Fig. 82b. Performance Memory Data Transmission Channels

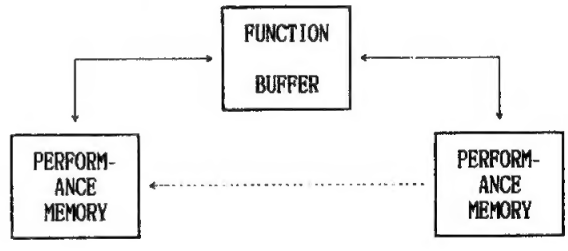
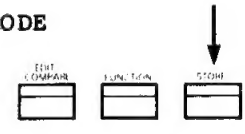


Fig. 83. Calling Store MODE



(1) STORE ALL
This STOREs VOICE MEMORY and PERFORMANCE MEMORY simultaneously. The Memory position can not be changed, and data can not be transferred between main unit and cartridge.

* The following is displayed: "STORE ALL FROM>>CURRENT EDITING TO>>CURRENT SELECTED?"

(2) STORE VOICE
STOREs VOICE data in each of the separate channels. Memory position can be changed, and

Data can be transferred between main unit and cartridge.

* The following is displayed in the Play mode: "STORE VOICE FROM>>INT A1-1 XXXX TO>>INT A1-1 YYYY?".
* The following is displayed in the Edit mode: "STORE VOICE FROM>>EDITING XXXX TO>>INT A1-1 YYYY?" (Fig. 85).
* "FROM>>INT A1-1" refers to the original number, "TO>>INT A1-1" refers to the STORE location, "XXXX" refers to the original Voice Name or Edited Voice Name, and "YYYY" refers to STORE location Voice Name.

(3) STORE PERFORMANCE
STOREs data in PERFORMANCE MEMORY. Memory position can be changed, and data can be transferred between main unit and cartridge.

* The following is displayed: "STORE PERFORMANCE FROM>>CURRENT XXXX TO>>INT P1-1 YYYY?" (Fig. 86).
* "XXXX" refers to the first ten letters of the original Performance Name or the changed Performance Name, "YYYY" refers to first ten letters of the Performance Name in the STORE location, and "TO>>INT P1-1" refers to the STORE location number.

Fig. 84. Store All LCD Display

```
STORE        FROM>>CURRENT EDITING
ALL            TO>>CURRENT SELECTED ?■
```

Fig. 85. Store Voice LCD Display

Play mode.

```
STORE        FROM>>INT.A1-1 XXXX
VOICE          TO>>INT.A1-1 YYYY    ?■
```

After editing.

```
STORE        FROM>>EDITING  XXXX
VOICE          TO>>INT.A1-1 YYYY    ?■
```

Fig. 86. Store Performance LCD Display

```
STORE       FROM>>CURRENT  XXXX
PERFORMANCE  TO>>INT.P1-1  YYYY    ?■
```

Memory Protect Function

There is a memory protect function which prevents accidental erasure of data in Internal Memory and in external RAM Cartridges. This should always be turnd OFF prior to engaging the STORE mode. Also, in order to prevent accidental erasure of the data after a STORE function has been completed, the Memory Protect function should be reset.

* With regard to the Internal Memory, the Performance & Voice switch 6 of the Function mode is selected, and according to PROTECT MEMORY Write, the Memory Protection Function is engaged. It can be disengaged by pressing the DATA ENTRY NO button. Protect Memory Write will be reset when power is turned on again after having been turned off.
* The RAM Cartridge has a Memory Protect switch, and when this is turned off, the Memory Protection Function is defeated.
* The ROM Cartridge is read-only. Since ROM cannot be written to, memory can not be erased.

6-2 Application of STORE ALL

STORE ALL Application Examples

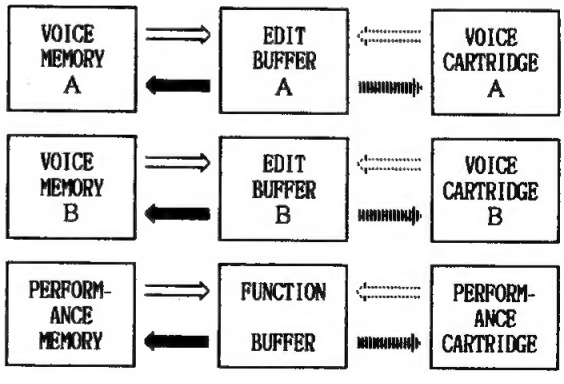
The STORE ALL function returns the data residing in the buffer to the original memory number of the VOICE MEMORY and PERFORMANCE MEMORY simultaneously. The following three types of data transfer are carried out at the same time:
Voice Edit Buffer A to DX1 VOICE MEMORY A or VOICE MEMORY Cartridge A.
Voice Edit Buffer B to DX1 VOICE MEMORY B or VOICE MEMORY Cartridge B.
Performance Edit Buffer to DX1 PERFORMANCE MEMORY or PERFORMANCE MEMORY Cartridge. (Fig 87).

* Data cannot be transferred between channels or between different memory numbers with the STORE ALL function.
* Data cannot be transferred between the DX1 and the Cartridge with STORE All. Data called from the DX1 is returned to the DX1, and data called from the Cartridge is returned to the Cartridge.

Data storage and data transfer can be carried out in the following cases:

* I: When VOICE MEMORY number data stored in the DX1 PERFORMANCE MEMORY is changed and returned to the original PERFORMANCE MEMORY number while in the Play mode.
* II: When VOICE MEMORY number data stored in the PERFORMANCE MEMORY Cartridge is changed and returned to the original Cartridge number while in the Play mode.
* III: When the voice data in the DX1 VOICE MEMORY is changed and returned to the original VOICE MEMORY number while in the Edit mode.
* IV: When the voice data in the VOICE MEMORY Cartridge is changed and returned to the original Cartridge number while in the Edit mode.
* V: When the DX1 PERFORMANCE MEMORY effect data is changed and returned to the original PERFORMANCE MEMORY number while in the Function mode.
* VI: When the Cartridge PERFORMANCE MEMORY effect data is changed and returned to the original Cartridge number while in the Function mode.

Fig. 87. Store All Transmission Channels



* VII: When the DX1 VOICE MEMORY number stored in the DX1 Performance Memory is changed while in the Play mode, when the voice data is changed while in the Edit mode, and when the effect data is changed and returned to the original DX1 PERFORMANCE MEMORY while in the Function mode (i.e., I, III and V combined).

The STORE ALL process (fig. 88)

The above VII operations can be accomplished with the following process.

(a) Turn all mode selectors OFF and enter the PLAY mode.
(b) Select the PERFORMANCE MEMORY STORE destination and call the data into the PERFORMANCE EDIT BUFFER.
(c) Select the voice data to be edited from both VOICE MEMORY channels and call the data into the VOICE EDIT BUFFER.
(d) Switch to the EDIT mode.
(e) Edit the data in the VOICE EDIT BUFFER of the flashing channel.
(f) Select the other channel by pressing the coninuously lit channel button.
(g) Edit the data in the VOICE EDIT BUFFER of the flashing channel.
(h) Switch to the FUNCTION mode.
(i) Edit the effect data in the PERFORMANCE EDIT BUFFER.
(j) Turn PROTECT MEMORY WRITE OFF.
(k) Switch to the STORE mode.
(l) STORE ALL is automatically selected.
(m) Press the DATA ENTRY YES button and the A/B VOICE EDIT BUFFER data and PERFORMANCE EDIT BUFFER data will be stored simultaneously.

* If the YES button is pressed while PROTECT MEMORY WRITE is still ON, the "**ERROR** Memory protected!" message will be displayed.

6-3 STORE VOICE APPLICATIONS

STORE VOICE Application Examples

The STORE VOICE function permits storing VOICE MEMORY data to a specified memory position. Data can be transferred from the A and B VOICE EDIT BUFFERs to the A and B internal memory or A and B cartridge memory (fig. 89).

* STORE VOICE can be performed only for one channel at a time.

The following data storage and transfer processes are possible:

* I: Storing VOICE MEMORY data (internal or cartridge) in a different memory position in the PLAY mode.
* II: Storing VOICE MEMORY data (internal or cartridge) in a different memory channel in the PLAY mode.
* III: Storing VOICE MEMORY data between the internal memory and an external cartridge in the PLAY mode.
* IV: Returning VOICE data (internal or cartridge) to the original memory position after editing in the EDIT mode.
* V: Storing VOICE data (internal or cartridge) in a new memory position after editing in the EDIT mode.
* VI: Storing VOICE data (internal or cartridge) in a different channel after editing in the EDIT mode.
* VII: Storing VOICE data in an external cartridge after editing in the EDIT mode.
* VIII: Storing VOICE data from an external cartridge in the internal memory after editinng in the EDIT mode.

The STORE VOICE process (fig. 90)

The above VII operations can be accomplished with the following process.

(a) Select the voice data to be edited from both VOICE MEMORY channels and call the data into the VOICE EDIT BUFFER.
(b) Insert a VOICE MEMORY RAM CARTRIDGE.
* Turn the CARTRIDGE switch OFF.
(c) Switch to the FUNCTION mode.
(d) Turn PROTECT MEMORY WRITE OFF.
(e) Turn the FUNCTION switch OFF.

Fig. 89. Store Voice Transmission Channels

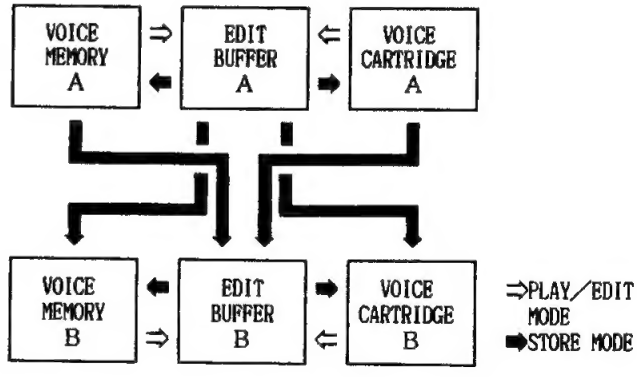


Fig. 88. Store All Operating Process

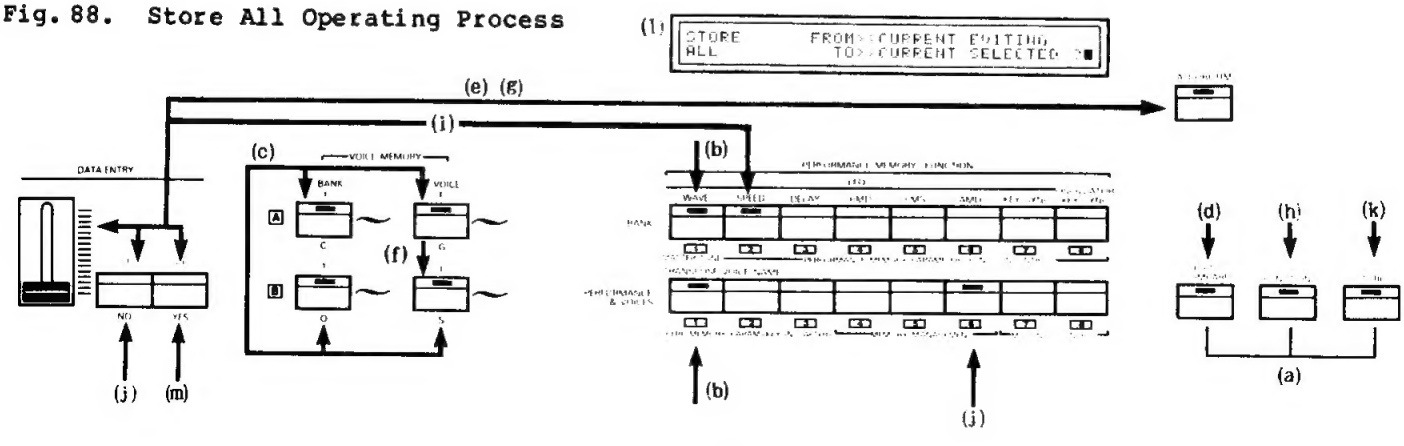
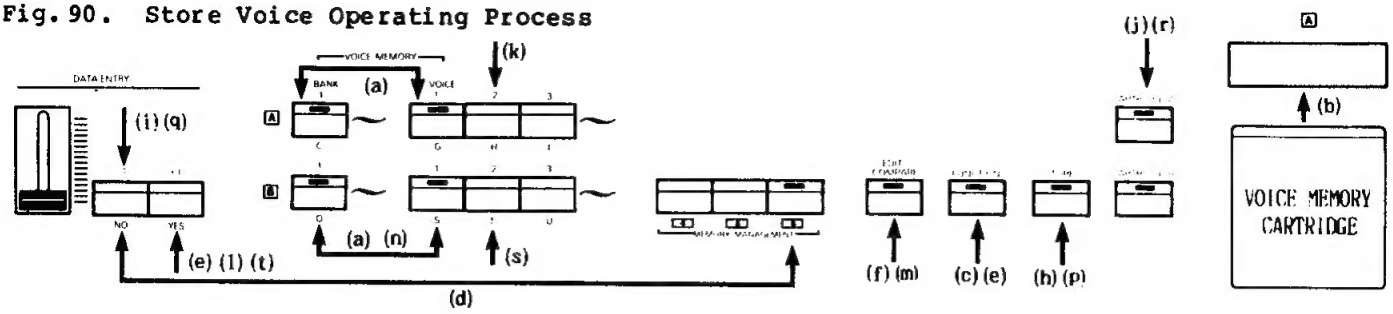


Fig. 90. Store Voice Operating Process



(f) Switch to the EDIT mode.
(g) Edit the data in the VOICE EDIT BUFFER of the flashing channel.
(h) Switch to the STORE mode.
(i) Using the DATA ENTRY NO button call the STORE VOICE mode.
(j) Turn the CARTRIDGE switch of the channel to be stored to ON.
* If an incorrectly formatted cartridge is inserted or the wrong access procedure is followed, the "**ERROR** Cartridge format conflict!" message will appear.
* If a cartridge is not inserted the "**ERROR** Cartridge not ready!" message will appear.
* If PROTECT MEMORY WRITE is ON the "**ERROR** W-protected!" message will appear.

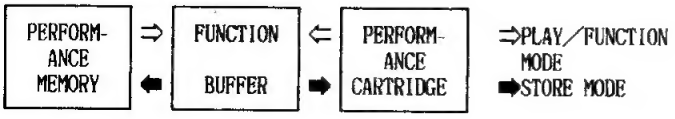
(k) Use the VOICE MEMORY switches to select the STORE destination position.
(l) Press te DATA ENTRY YES button to initiate the STORE operation, causing the edited data in the buffer to be sent to the cartridge.
(m) The EDIT mode will be returned to automatically.
(n) Press the other channel button to switch channels.
(o) Edit the data in the VOICE EDIT BUFFER of the flashing channel.
(p) Switch to the STORE mode.
(q) Using the DATA ENTRY NO button call the STORE VOICE mode.
(r) Turn the CARTRIDGE switch of the channel to be stored to ON.
(s) Use the VOICE MEMORY switches to select the STORE destination position.
(t) Press the DATA ENTRY YES button to initiate the STORE operation, causing the edited data in the buffer to be sent to the cartridge.

6-4 STORE PERFORMANCE APPLICATION

STORE PERFORMANCE application examples

STORE PERFORMANCE permits storing data in a specified PERFORMANCE MEMORY position. Data can be transferred from the PERFORMANCE EDIT BUFFER to an internal PERFORMANCE MEMORY position or to an external PERFORMANCE MEMORY CARTRIDGE.

Fig. 91. Store Performance Transmission Channels



* The STORE PERFORMANCE function permits storing PERFORMANCE MEMORY parameters (VOICE MEMORY number, CARTRIDGE switch ON/OFF status, KEY ASSIGN MODE, etc,).

The following data storage and transfer processes are possible:

* I: Storing PERFORMANCE MEMORY data (internal or cartridge) in a different memory position in the PLAY mode.
* II: Storing PERFORMANCE MEMORY data between the internal memory and a cartridge memory in the PLAY mode.
* III: Editing the voice memory number data in a PERFORMANCE MEMORY position and re-storing it in the original memory position in the PLAY mode.
* IV: Editing the voice memory number data in a PERFORMANCE MEMORY and storing it in a different memory location in the PLAY mode.
* V: Editing the voice memory number data in an internal PERFORMANCE MEMORY and storing it in an external PERFORMANCE MEMORY CARTRIDGE.
* VI: Editing the voice memory number data in PERFORMANCE MEMORY data from an external cartridge and storing it in the internal PERFORMANCE MEMORY in the PLAY mode.
* VII: Storing edited PERFORMANCE MEMORY effect data (internal or cartridge) back in the original PERFORMANCE MEMORY position in the FUNCTION mode.
* VIII: Storing edited PERFORMANCE MEMORY effect data (internal or cartridge) in a different memory position in the FUNCTION mode.
* IX: Storing edited PERFORMANCE MEMORY effect data in an external cartridge in the FUNCTION mode.
* X: Storing PERFORMANCE MEMORY effect data called from an external cartridge and edited in the internal PERFORMANCE MEMORY in the FUNCTION mode.

The STORE PERFORMANCE process (fig. 92)

The above X operations can be accomplished with the following process:

(a) Insert a PERFORMANCE MEMORY CARTRIDGE into cartridge slot A.
(b) Press the CARTRIDGE switch while holding a PERFORMANCE MEMORY switch to access the cartridge.
* (b) is the procedure for accessing PERFORMANCE MEMORY (FORMAT = 01) cartridges.
* If an incorrectly formatted cartridge is inserted or the wrong access procedure is

followed, the "**ERROR** Cartridge format conflict!" message will appear.

* If a cartridge is not inserted the "**ERROR** Cartridge not ready!" message will appear.

(c) The end of the upper row of the performance name display will read "<<CARTRIDGE>>" indicating the PERFORMANCE MEMORY cartridge is being accessed.

(d) Select the PERFORMANCE MEMORY data to be edited and call it into the PERFORMANCE EDIT BUFFER.

(e) Switch to the FUNCTION mode.

(f) Edit the effect data.

(g) Turn PROTECT MEMORY WRITE OFF.

(h) Switch to the STORE mode.

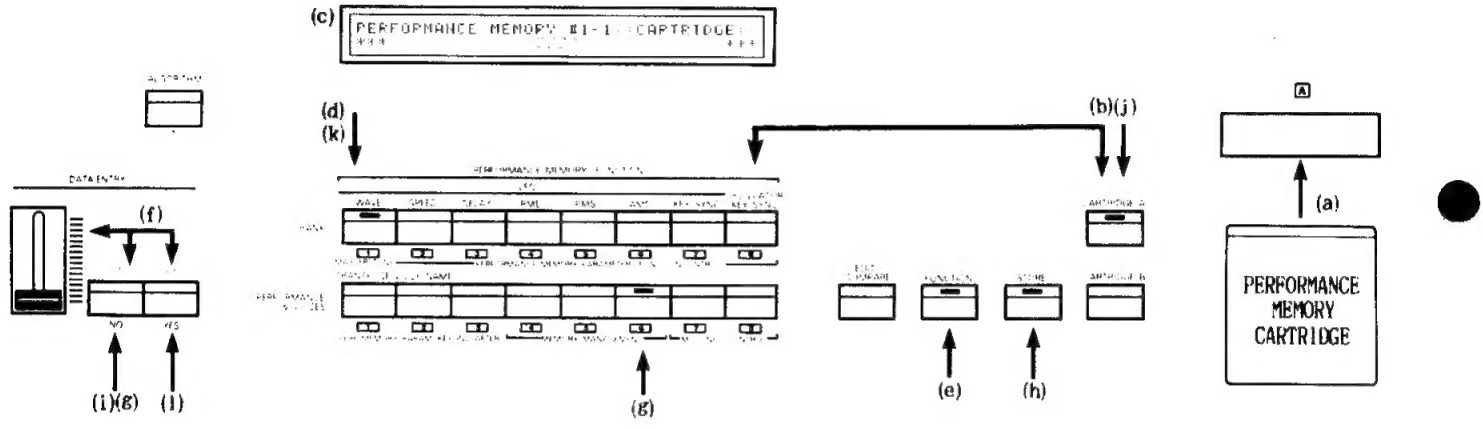
(i) Press the DATA ENTRY NO button to call the STORE PERFORMANCE function.

(j) Turn the CARTRIDGE switch OFF.

(k) Select the destination PERFORMANCE MEMORY position.

(l) Press the DATA ENTRY YES button to initiate the STORE process. The data in the PERFORMANCE EDIT BUFFER will be transferred to the designated PERFORMANCE MEMORY position.

Fig. 92. Store Performance Operating Process



CHAPTER 7

VOICE INITIALIZE/PROGRAMMING A NEW VOICE

In this section we'll look at the steps involved in creating a completely new voice using initialized voice and effect parameters. As an example, we'll program a "HORN ENSEMBLE" voice with a stereo effect.

* The voice to be programmed in this chapter is not included in the DX1 preset voices.

7-1 Programming a voice from the INITIALIZE MEMORY state

(1) THE VOICE PROGRAMMING FLOW CHART

When beginning to program a voice from the initialized state, the proper procedure must be followed to achieve the highest efficiency. The finer details of the process will vary according to the type of voice that is to be programmed, but to create a voice using both channels A and B with a stereo effect, the following general procedure should be followed.

* Call the initialized data ⇨
* Enter the channel A voice data ⇨
* Store the voice data and alter channel B.
* Enter effect data and effect controller data.
* Store the effect data.

(2) CALLING THE INITIALIZED DATA (fig. 94)

The FUNCTION mode MEMORY MANAGEMENT buttons are used to call the INITIALIZE MEMORY function.

(a) INITIALIZE VOICE
Switch to the FUNCTION mode, and run the INITIALIZE VOICE function on both channels.

* With INITIALIZE VOICE, the initialized voice parameter data for each channel can be called into the VOICE EDIT BUFFER. →P.44
* Normally, INITIALIZE VOICE will be performed on both channels, In this case, however, we'll initialize channel A only, enter the voice data, copy the channel A data to channel B and alter it. It is therefore only necessary to initialize channel A. →P.45
* The initial data created by the INITIALIZE VOICE function is not totally "blank" data, as is created by the

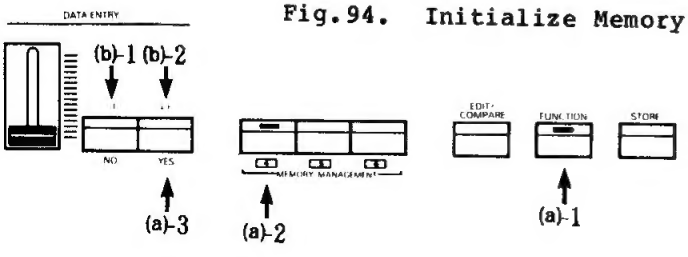


Fig.94. Initialize Memory

Fig.93. Flowchart: Creating Voice from the Initial Data

Calling initial data.

(a)INITIALIZE VOICE ····· A・B ···· FUNCTION MODE
(b)INITIALIZE PERFORMANCE ····· FUNCTION MODE

⇩

Entering voice data in channel A.

(c)ALGORITHM ····· A ····· EDIT MODE
(d)OCILLATOR ····· A ····· EDIT MODE
(e)OPERATOR OUTPUT LEVEL ····· A ····· EDIT MODE
(f)ENVELOPE GENERATOR ····· A ····· EDIT MODE
(g)KEYBOARD SCALING ····· A ····· EDIT MODE
(h)KEY VELOCITY ····· A ····· EDIT MODE
(i)LFO ····· A ····· EDIT MODE
(j)TRANSPOSE ····· A ····· EDIT MODE

⇩

Storing voice data and correcting channel B.

(k)VOICE NAME ····· A ····· EDIT MODE
(l)STORE ALL ····· A ····· STORE MODE
(m)STORE VOICE ····· A⇨B ····· STORE MODE
(n)EDIT PARAMETER ····· B ····· EDIT MODE
(o)STORE ALL ····· B ····· STORE MODE

⇩

Entering effect data and effect control data.

(p)F1 : DUAL MODE DETUNE etc ····· FUNCTION MODE
(q)F2 : POLY/MONO etc ····· A・B ···· FUNCTION MODE
(r)F3 : PITCH BEND ····· A・B ···· FUNCTION MODE
(s)F4 : PORTAMENTO ····· A・B ···· FUNCTION MODE
(t)F5 : SUSTAIN PEDAL ASSIGN etc ····· A・B ···· FUNCTION MODE
(u)F6 : MOD. WHEEL・FOOT CONT. ····· A・B ···· FUNCTION MODE
(v)F7 : BRTH CONT.・AFTER TOUCH ····· A・B ···· FUNCTION MODE
(w)F8 : SPLIT POINT ・KEY SHIFT ····· A・B ···· FUNCTION MODE
(x)F9~11 : KEY INDIV. AFTER TOUCH ···· A・B ···· FUNCTION MODE

⇩

Storing effect data.

(y)F8 : PERFORMANCE NAME ····· FUNCTION MODE
(z)STORE PERFORMANCE ····· STORE MODE

formatting of RAM cartridges. Instead, all parameters are set to values which make subsequent voice programming as easy as possible.

* When INITIALIZE VOICE is used, the EDIT indicator will light even though the FUNCTION mode is selected. Then, simply by turning the FUNCTION switch OFF, the EDIT mode is automatically selected permitting immediate data entry.
* In this case, first use the INITIALIZE PERFORMANCE function and then exit the FUNCTION mode.

(b) INITIALIZE PERFORMANCE
While still in the FUNCTION mode, run the INITIALIZE PERFORMANCE function.

* The INITIALIZE PERFORMANCE function calls initialized PERFORMANCE MEMORY parameter data into the PERFORMANCE EDIT BUFFER. →P.43
* As with INITIALIZE VOICE, INITALIZE PERFORMANCE does not create totally "blank" data. The parameters are set up for the easiest programming. →P.44
* Since the OP 2--6 OPERATOR OUTPUT LEVEL in both channels A and B are initially set at 0, the only sound that will be hear at this point is that of the OP 1 carrier. No FM effects will be heard. →P.5
* After running INITIALIZE PERFORMANCE, turn the FUNCTION switch OFF to exit from the FUNCTION mode.

7-2 ENTERING VOICE PARAMETER DATA

Here, only the channel A data will be entered. The channel A data will then be copied to channel B and altered.

* In order to hear the results of the data entered, the OPERATOR OUTPUT LEVEL of OP 2 through OP 6 should be set at around 90.
* Make sure that all operators are ON.
* While programming the voice parameters, play a key within the most commonly used horn range (A1--C2). The maximum range of a horn is from F0 to F4.
* After completing each programming step, it is a good idea to save the programmed data with the STORE ALL function to prevent accidental data loss.

(1) ENTERING THE CHANNEL A VOICE DATA
(fig. 95. 96)

(c) ALGORITHM : A →P.22
The basic tone generator characteristics will be set in this section.

* ALGORITHM ⇨ 3
Algorithm 1 is automatically selected, but it is necessary to select an algorithm which is most suited to the target horn voice. We'll use algorithm 3, which has 2 carriers, each with 2 modulators.
* OP 1 will be used to create the slow timbre variation of a horn, and OP 4 with feedback will be used to add the horn's distinctive "rasping" effect.
* FEEDBACK ⇨ 7
FEEDBACK is used to generate noise. Set FEEDBACK to 7.

(d) OSCILLATOR : A →P.22
More "basic" tone generator settings.

* MODE ⇨ OP 1--6 = FREQUENCY RATIO (no change)
* COARSE, FINE ⇨ OP 1--6 = 1.00 (no change)
A setting of 1.00 makes for the easiest programming of brass instrument harmonics.
* DETUNE ⇨ OP 1--6 = 0 (no change)
* The chorus effect will be created using DUAL MODE DETUNE in step (p). If more richness is required, DETUNE can be programmed later.
* KEY SYNC ⇨ ON (no change) ⇨ PERFORMANCE MEMORY -- BANK 8 →P.29

(e) OPERATOR OUTPUT LEVEL : A →P.27
⇨ OP 1, 4 = 99/ OP 2, 3, 5, 6 = 70
The carrier operator (OP 4) is set to 99. The modulator operators are all set to 70 to give a softness to the sound. This completes the basic voicing.

(f) ENVELOPE GENERATOR : A →P.23
Once this step is complete, the sound will be close to the desired horn voice.

* EG
⇨ OP 1, 4 : R1--4 = 99/ L1--3 = 99/ L4 0 (no change)
⇨ OP 2, 3 : R1, R2 = 50/ R3, R4 = 99/ L1 = 99/ L2--4 = 0
⇨ OP 5, 6 : R1 = 65/ R2 = 50/ R3, R4 = 99/ L1 = 99/ L2--4 = 0
OP 2 and 3 create the horn's gentle timbre variation. The R1 of OP 5 and 6 is set faster than Op 2 and 3 to bring out the raspiness of brass instruments.
* Since many modulators use the same data, the FUNCTION mode MEMORY MANAGEMENT COPY ENVELOPE DATA function can shorten the

Fig.95. Entering Voice Data (Algorithm)

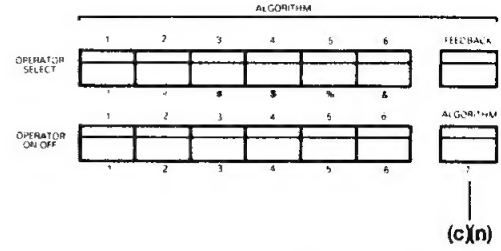
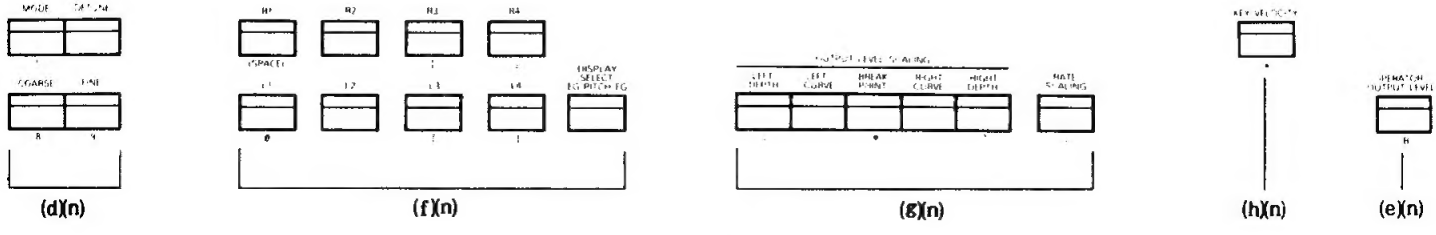


Fig. 96. Entering Voice Data (Oscillator-Key Velocity)



data entry process.
* If the envelope variation is insufficient, increase the OPERATOR OUTPUT LEVEL of the modulators.
* PITCH EG ⇨ R1--4 = 99/ L1--4 = 50 (no change)
* If R1 = 60 and L4 = 48, a pitch slur at initial attack can be created.

(g) KEYBOARD SCALING : A →P.25
This function is used to create a generally brighter, brassier tone outside the horn's central range.
* LEVEL SCALING
⇨ OP 1, 3--6 : DEPTH L, R = 0/ CURVE L, R = -LIN/ BREAK POINT = 0 (no change)
⇨ OP 2 : DEPTH L = 20, DEPTH R = 10/ CURVE L, R = +LIN/ BREAK POINT = 30
For greater brightness, increase the level of OP 2.
* RATE SCALING ⇨ OP 1--6 = 0 (no change)

(h) KEY VELOCITY : A →P.26
⇨ OP 1, 4 = 5/ OP 2, 3, 5, 6 = 3
This creates the effect that the harder the horn is blown, the louder and brighter the tone.

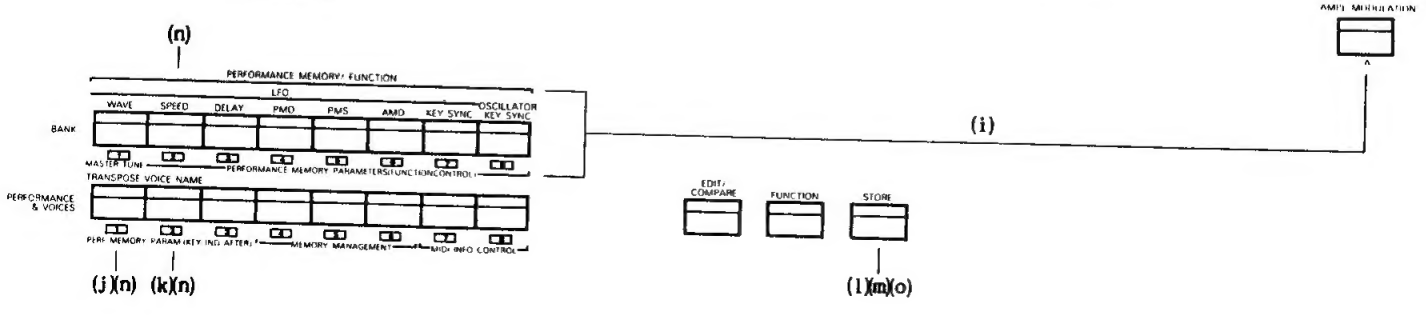
(i) LFO : A →P.27~P.29
The SENSITIVITY block AMPL. MODULATION and PERFORMANCE MEMORY section LFO parameters are set so that the MODULATION WHEEL can be used to control the stereo tremolo effect, and the FOOT CONTROLER can be used for volume control.
* The effects can not be used until the FUNCTION mode MOD. WHEEL and FOOT CONT. data are entered.
* AMPL. MODULATION ⇨ OP 1, 4 = 3/OP 2, 3, 5, 6 = 2

Carrier modulation for tremolo and modulator modulation for wow are added.
* WAVE ⇨ TRIANGLE (no change)
* SPEED ⇨ 12
* DELAY ⇨ 0 (no change)
* PMD ⇨ 0 (no change)
* PMS ⇨ 0

Vibrato is not used with this voice, so PMS = 0.
* If vibrato is to be added with after touch response, etc, set PMS at 3.
* AMD ⇨ 0 (no change)
* KEY SYNC ⇨ ON (no change)

(j) TRANSPOSE : A ⇨ +00 (no change) →P.30
* This is normally only used if the range of the target voice is outside that of the DX1 keyboard.
* The TRANSPOSE function can be used to place the programmed voice's most commonly used range in the most accessible portion of the keyboard.

Fig. 97. Entering Voice Data (LFO, Transpose) and Storing



(2) STORING THE VOICE DATA AND ALTERING THE CHANNEL B DATA (fig. 95--97)

(k) VOICE NAME : A (no change) →P.30
* Normally, the voice name should be programmed when the voice data for channel A has been set.

(l) STORE ALL : A →P.62
When the voice data has all been set for channel A, use STORE ALL to store the data from the VOICE EDIT BUFFER A into VOICE MEMORY A.
* STORE VOICE could also be used for this.

(m) STORE VOICE : A ⇨ B →P.62
The voice data stored in VOICE MEMORY A is copied to VOICE MEMORY B.
* In this case, the EDIT mode is automatically entered as soon as the STORE is complete. Then, by switching to channel B, the data copied from channel A can be edited.

(n) VOICE PARAMETER : B →P.21~P.30
The necessary alterations will be made to the VOICE PARAMETERS in channel B.
* Here, only the LFO SPEED parameter necessary to create the stereo tremolo effect will be altered.
* LFO SPEED ⇨ 10
This was set to 12 in channel A. It is set for a slower speed here.
* With this "close" speed setting (12 in A, 10 in B), a stereo effect in which the tremolo effect is somewhat "blurred" is created.
*A more distinct tremolo sound can be created by setting the channel A speed to 12 and the channel B speed to 6.

(o) STORE ALL : B
This time, the edited data in the channel B VOICE EDIT BUFFER is stored in the VOICE MEMORY.

7-3 ENTERING THE PERFORMANCE MEMORY PARAMETERS

Most of the FUNCTION mode effect parameters are independent for each channel. Since the PERFORMANCE MEMORY is the same for both channels, however, the data cannot be copied from one channel to the other. The PERFORMANCE MEMORY parameters must be entered into each channel directly for each programming step.

* Accidental data loss can be prevented by using the STORE ALL function to store the data from the BUFFER into the main memory after each step of the voice programming process.

* Enter the FUNCTION mode before performing the following operations.

(1) ENTERING EFFECT AND EFFECT CONTROLLER DATA (fig. 98)

(p) F1 : DUAL MODE DETUNE etc →P.35
* This functions simultaneously for channels A and B.
* MASTER TUNE ⇨ +00 (no change)
Master tune must be set to +00 to achieve reference pitch.
* DUAL MODE DETUNE ⇨ 10
The channel A and B voices have been made virtually identical to support the stereo effect. Using the DUAL MODE DETUNE function it is possible to create a stereo chorus effect independently from the stereo tremolo effect.
* OSCILLATOR DETUNE can be used to create an even deeper chorus effect.

(q) F2 : POLY/MONO etc →P.35
* POLY/MONO : A, B ⇨ POLY (no change)
* MONO is used for solo or monophonic instrument voices.
* SOURCE SELECT : A, B ⇨ 0 (no change)

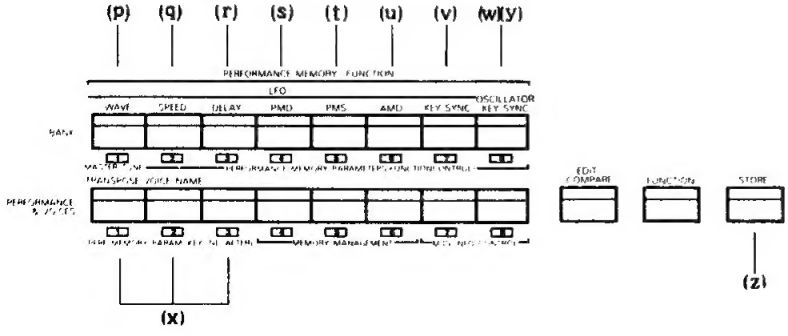
(r) F3 : PITCH BEND →P.36
* PITCH BEND RANGE : A, B ⇨ 5 (no change)
By setting the A and B ranges differently, a variable detune effect can be created.
* PITCH BEND STEP : A, B ⇨ 0 (no change)

(s) F4 : PORTAMENTO →P.36
* PORTAMENTO/GLISSANDO : A, B ⇨ PORT (no change)
* PORTAMENTO MODE : A, B ⇨ RETAIN (no change)
* PEDAL ASSIGN : A, B ⇨ ON (no change)
* TIME : A, B ⇨ 0 (no change)
* Portamento is an extremely important factor in string instrument voices.

(t) F5 : SUSTAIN PEDAL ASSIGN, etc →P.37
* OUTPUT LEVEL ATTENUATE : A, B ⇨ 7 (no change)
* PROG. OUTPUT ASSIGN : A, B ⇨ ON (no change)
* SUSTAIN PEDAL ASSIGN : A, B ⇨ ON (no change)
* Basically, a sustain effect is not normally used with continuous-tone instruments like brass or organ.

(u) F6 : MOD. WHEEL, FOOT CONT. →P.38
The modulation wheel is set to control tremolo, and the foot controller is set to control volume.
* MOD. WHEEL SENSITVITY : A, B ⇨ 15 (no change)
* MOD. WHEEL ASSIGN : A, B ⇨ 010
010 = AMD, permitting tremolo control.

Fig. 98. Establishing Performance Memory Parameters



* FOOT CONT. SENSITIVITY : A, B ⇨ 15
This is set to 15 so that a foot controller plugged into the rear-panel MODULATION jack can be used to control volume from OFF to MAX.
* FOOT CONT. ASSIGN : A, B ⇨ 100
100 = EBC, permitting volume control.
* If LFO SPEED is set to about 35 and FOOT CONT. ASSIGN is set to 001 (PMD), the foot controller can be used for vibrato control.

(v) F7 : BRTH CONT., AFTER TOUCH →P.39
* BRTH CONT. SENSITIVITY : A, B ⇨ 0 (no change)
* BRTH CONT. ASSIGN : A, B ⇨ 000 (no change)
* The BC1 breath controller can be used to "blow" the horn voice if BRTH CONT. SENSITIVITY is set to 15 and BRTH CONT. ASSIGN is set to 100.
* AFTER TOUCH SENSITIVITY : A, B ⇨ 0 (no change)
* AFTER TOUCH ASSIGN : A, B ⇨ 000 (no change)
* If LFO SPEED is set to about 35, AFTER TOUCH SENSITIVITY is set to 5--15, and AFTR TOUCH ASSIGN is set to 001, after touch vibrato control is possible.

(w) F8 : SPLIT POINT etc →P.40
* SPLIT POINT = A, A ⇨ C3 (no change)
When completely different voices from channel A and B are used, the KEY ASSIGN MODE can be set to SPLIT, and the channel A voice played on the section of the keyboard below the SPLIT POINT while the channel B voice is played above the SPLIT POINT.
* KEY SHIFT : A, B ⇨ +00 (no change)

(x) F9--11 : KEY INDIV. AFTER TOUCH →P.40
A shallow KEY INDIVIDUAL AFTER TOUCH effect is programmed. The level and timbre of individual notes within a chord can be individually varied.
* TOTAL SENSITIVITY : A, B ⇨ 15
TOTAL SENSITIVITY is set to 15 and overall balance is adjusted using the individual OPERATOR DEPTH parameters.
* DECAY RATE : A, B ⇨ 50--99
A fast DECAY RATE is set for a sharp variation.
* RELEASE RATE : A, B ⇨ 99 (no change)
* A sustain effect is produced if RELEASE RATE is set to a small value.
* OP 1--6 DEPTH : A, B ⇨ 7

(2) STORING THE EFFECT DATA (fig. 98)

(y) F8 : PERFORMANCE NAME →P.40
* Normally a total voice/effect name, an effect-only name or the programmed date is given once the effect data has been entered.

(z) STORE PERFORMANCE →P.53
The completed effect data in the PERFORMANCE EDIT BUFFER is stored into the PERFORMANCE MEMORY.
* After using STORE PERFORMANCE, exit the FUNCTION mode.
* CAUTION: If the FUNCTION mode is exited and different PERFORMANCE MEMORY is selected before the STORE PERFORMANCE function is used, the data in the PERFORMANCE EDIT BUFFER will be lost.

CHAPTER 8

USING THE MIDI TERMINALS

In this chapter we'll take a close look at how the MIDI terminals on the DX1 can be used to set up a system with other instruments and equipment, and how the system can be operated.

8-1 ABOUT THE MIDI TERMINALS

(1) MIDI SPECIFICATIONS

MIDI stands for Musical Instrument Digital Interface. This system permits sending control data back and forth between MIDI compatible instruments and other equipment. →P.73

* Signal Types

The digital MIDI signals must confirm closely to a predetermined set of specifications for maximum compatibility. Therefore, MIDI control can only be used with instruments or other equipment specifically designed for MIDI compatibility. In the DX1, the MIDI signals are basically divided into 2 groups: CHANNEL INFORMATION and SYSTEM INFORMATION.

**CHANNEL INFORMATION

This group of signals incorporates the performance data: i.e. "remote control" signals such as key ON/OFF and effect controller status. These fall under the heading of BASIC EVENT DATA. Voice memory selection, and data entry data fall in the OTHER EVENT DATA category within the CHANNEL INFORMATION signal group. Hovever, the receiving instrument or equipment may not have all the features controllable by these signals, making the corresponding signals unusable.

* Main BASIC EVENT DATA signals →P.73
KEY ON/OFF
KEY NUMBER
KEY VELOCITY (INITIAL TOUCH)
PITCH BEND
SUSTAIN ON/OFF

* Main OTHER EVENT DATA signals →P.74
LFO MODULATON
EG BIAS
PORTAMENTO TIME
PORTAMENTO ON/OFF
PROGRAM CHANGE
(VOICE NUMBER/PERFORMANCE NUMBER)
DATA CHANGE (DATA ENTRY)

**SYSTEM INFORMATION

This signal group includes SYSTEM EXCLUSIVE DATA (memory data transfer, parameter switchihg) and SYSTEM REAL TIME DATA (sequencer control). In particular, SYSTEM EXCLUSIVE DATA is highly dependent on the functions and data format of the instrument used, and cannot be used with instruments or equipment having a different system. SYSTEM EXCLUSIVE DATA can currently only be used with Yamaha DX series synthesizers and related equipment. If the receiving instrument is not a DX1, some of the signals described below may not be usable, depending on the functions and features of the receiving instrument.

* Main SYSTEM EXCLUSIVE DATA signals →P.74
VOICE EDIT BUFFER DATA
(ONE VOICE BULK DATA)
PERFORMANCE EDIT BUFFER DATA
(ONE PERFORMANCE BULK DATA)
VOICE MEMORY DATA
(ALL VOICE BULK DATA)
PERFORMANCE MEMORY DATA
(ALL PERFORMANCE BULK DATA)
VOICE PARAMETER CHANGE
FUNCTION PARAMETER CHANGE

* Main SYSTEM REAL TIME DATA signals →P.75
REMOTE SEQUENCE (START/PAUSE/STOP)

* Signal Channels

16 indepedent MIDI data channels (1--16) are incorporated, and each can be independently controlled. The channel used depends on the instrument or piece of equipment used. The channel used by the receiving equipment must be matched with that of the transmitting equipment.

* The DX1 transmission channel is channel 1.
* When the DX1 is to receive data from an external source, the FUNCTION mode F2 SOURCE SELECT function must be used to match the receiving channel in the DX1 with the transmitting channel in the external data source. Channel 0 is the DX1 keyboard. →P.36
* If the OMNI mode is set using the FUNCTION mode F15 SET STATUS function, reception on all channels simultaneously is possible. This is useful if the channel of the transmitting equipment is not known, or it is necessary to reveive on more than one channel at once.

* The Connectors

The MIDI connector specifications are rigidly determined to ensure full compatibility between all MIDI equipment.

**Connector

The standard MIDI connector is a DIN type.

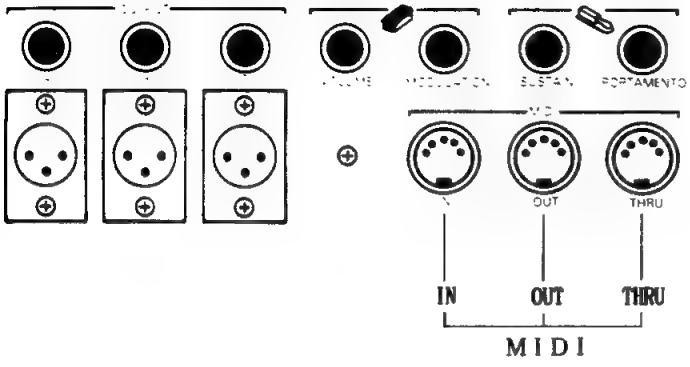
* The instrument-side connector is a 5-pin DIN jack.
* The MIDI connection cable is fitted with 5-pin DIN plugs on both ends. Please use the optional MIDI cables: MIDI-03 (3 meters) or MIDI-15 (15 meters).

**MIDI IN, MIDI OUT, MIDI THRU

The MIDI connectors are provided on the rear panel. Three connectors are provided MIDI OUT, MIDI IN, and MIDI THRU (fig. 99).

* MIDI IN: receives signals from an external source.
* MIDI OUT: Transmits signals to an external receiver.
* MIDI THRU: Outputs the same signal received at MIDI IN.

Fig. 99. MIDI Terminals



(2) Some MIDI system examples

The MIDI terminals can be used to create an almost unlimited variety of music systems. The following are a few examples.

* Real time control of the DX1 from an external instrument or equipment.

  * I: Remote keyboatd ⇨ DX1.
    That is, play the DX1 from a remote keyboard.
  * II: MIDI compatible instrument ⇨ DX1.
    Play the DX1 from another instrument, including other DX series keyboards.
  * III: MIDI sequencer ⇨ DX1.
    Automatic performance under the control of an external MIDI sequencer.
  * IV: Computer ⇨ MIDI interface ⇨ DX1.
    A MIDI interface can be used to connect a computer to the DX1 for automatic performance, computer composition and editing.

* Real time control of an external instrument or equipment from the DX1.

  * V: DX1 ⇨ MIDI instrument.
    Use the DX1 to control another MIDI keyboard, including the DX series keyboards.
  * VI: DX1 ⇨ MIDI interface ⇨ computer.
    Storing data in an external computer from the DX1, via a MIDI interface (Real -time sequencer control, composition software control, etc.).

* Mutual real time control between the DX1 and an external instrument or equipment.

  * VII: DX1 ⇦⇨ DX series keyboard.
    Mutual data entry between the DX1 and another DX series keyboard.
  * VIII: DX1 ⇦⇨ MIDI interface ⇦⇨ Computer.
    Mutual data entry between the DX1 and a computer (voice programming support software, etc.).

* Mutual data transfer between a DX1 and an external instrument or equipment.

  * IX: DX1 ⇦⇨ DX series keyboard.
    Mutual memory data transfer between the DX1 and another DX series keyboard.
  * X: DX1 ⇦⇨ MIDI interface ⇦⇨ Computer.
    Mutual memory data transfer between the DX1 and a computer.

8-2 MIDI SYSTEM CONNECTIONS AND OPERATIONS

(1) Controlling the DX1 from a remote keyboard

In this example the keyboard, voice selectors and effect controllers of an external keyboard, such as the Yamaha KX1, are used to control the DX1 (fig. 100).

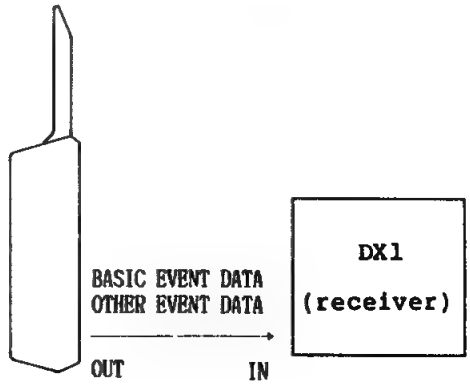
* Main Signal Contents.

  * Reception: BASIC EVENT DATA, OTHER EVENT DATA.

* Connection and Operating Procedure

  (a) Connect the remote keyboard MIDI OUT terminal to the DX1 MIDI IN terminal.
  * If it is desired to simultaneously control other instruments as well, connect as follows:
    Remote keyboard MIDI OUT ⇨ Instrument 1 MIDI IN.
    Instrument 1 MIDI THRU ⇨ Instrument 2 MIDI IN, etc.
  (b) Switch the DX1 to the FUNCTION mode, and set F15 MIDI SWITCH ON.
  (c) Turn the F15--SET STATUS--OMNI mode ON.
  * Reception is also possible if the F2 SOURCE SELECT function is used to turn all PERFORMANCE MEMORY NUMBER related channels ON.
  * POLY/MONO mode selection is only possible when the reception channel is matched.
  * The KX1 transmission channel is channel 1.
  (d) Call the F15--SET STATUS--PROGRAM CHANGE MODE and the VOICE/PERFORMANCE MEMORY group to be selected from the remote keyboard.

Fig. 100. Control Through a Remote Keyboard



(e) Switch to the PLAY mode.
* If the DX1 is in the FUNCTION mode, PROGRAM CHANGE can not be received making voice switching impossible.
(f) The DX1 can now be played via the remote keyboard.
* The KX1 transmits BASIC EVENT DATA and OTHER EVENT DATA.
* Normally, the DX1 channel A is switched via the KX1 BANK and VOICE selectors. If the KX1 SUSTAIN switch is held while a BANK or VOICE switch is pressed, the DX1 will switch to channel B.

(2) Playing the DX1 From Another Instrument

This permits playing the DX1 from another MIDI compatible keyboard instrument.

*Main Signal Contents

* Reception : BASIC EVENT DATA, OTHER EVENT DATA.

* Connection and Operating Procedure

(a) Connect the transmitting keyboard MIDI OUT terminal to the DX1 MIDI IN terminal.
* If it is desired to simultaneously control other instruments as well, connect as follows:
Transmitting keyboard MIDI OUT ⇨ Receiving Instrument 1 MIDI IN.
Receiving Instrument 1 MIDI THRU ⇨ Receiving Instrument 2 MIDI IN, etc.
(b) Switch the DX1 to the FUNCTION mode, and set F15 MIDI SWITCH ON.
(c) Turn the F15--SET STATUS--OMNI mode ON.
* Reception is also possible if the F2 SOURCE SELECT function is used to turn all PERFORMANCE MEMORY NUMBER related channels ON.
* The DX1, DX7, DX9 transmission channel is channel 1.
* If the DX1 SOURCE SELECT is set to 0, and the OMNI MODE is ON, control is possible directly at the DX1 controls as well as from the external instrument.
(d) Call the F15--SET STATUS--PROGRAM CHANGE MODE and the VOICE/PERFORMANCE MEMORY group to be selected from the transmitting keyboard.
(e) Switch to the PLAY mode.
* If the DX1 is in th FUNCTION mode, PROGRAM CHANGE can not be received making voice switching impossible.
(f) The DX1 can now be played via the transmitting keyboard.
* The voice played is set by the received PROGRAM CHANGE data. The transmitting keyboard voices have no effect on the selected voice.
* If the FUNCTION mode F15--SYSTEM EXCLU. COMMUNICATION function is turned ON, the DX1 voice data can be edited from an external DX1, DX7 or DX9.

(3) Controlling the DX1 from a Sequencer

It is possible to automatically "play" the DX1 from an external sequencer. The sequencer START, PAUSE and STOP commands can be issued from the DX1 control panel (fig. 102).

*Main Signal Contents

* Reception : BASIC EVENT DATA
* Transmission : SYSTEM REAL TIME DATA

* Connection and Operating Procedure

In a polyphonic sequencer a number of MIDI channels are used according to the number of "parts" to be played. If the sequencer does no have a function that permits assigning the transmission channels, the procedure for setting up for polyphonic sequence control and that for monophonic sequence control will be different.

(a) Connect the sequencer MIDI OUT terminal to the DX1 MIDI IN terminal.
* If it is desired to simultaneously control other instruments as well, connect as follows:
Sequencer MIDI OUT ⇨ Instrument 1 MIDI IN. Instrument 1 MIDI THRU ⇨ Instrument 2 MIDI IN, etc.
(b) Connect the DX1 MIDI OUT to the sequencer MIDI IN.
* When more than one instrument is being controlled by the sequencer, connect the MIDI OUT of the most-used instrument to the sequencer MIDI IN.
(c) Switch the DX1 to the FUNCTION mode, and set F15 MIDI SWITCH ON.
(d) Turn the F15--SET STATUS--OMNI MODE ON
* Reception is also possible if the F2 SOURCE SELECT function is used to turn all PERFORMANCE MEMORY NUMBER related channels ON.
* When a single DX1 is being controlled and the sequencer does not permit assigning transmission channels, set the F15--OMNI MODE ON.
* If the transmisson channels for different parts of a piece are separated at the

Fig. 101. Control via Other MIDI Compatible Instruments

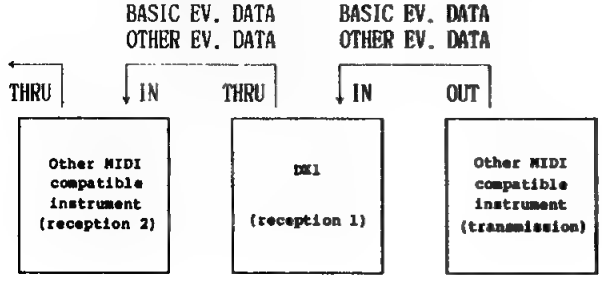
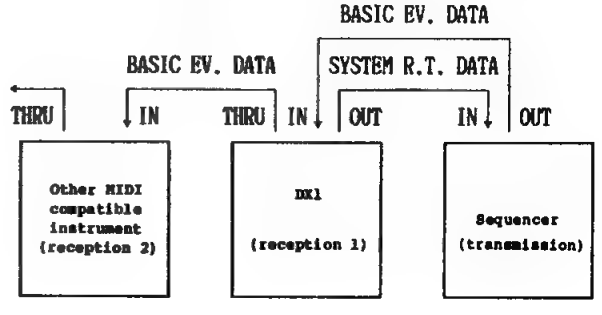


Fig. 102. Automatic Performance via Sequencer



sequencer, an automated ensemble performance can be created by controlling a number of instruments all set to receive different "part" channels.
* If the OMNI MODE is ON and the F2--SOURCE SELECT is set to 0, the DX1 keyboard can be played during sequencer playback.

(e) Turn F15--SET STATUS--BASIC EVENT DATA OUTPUT ON.
* BASIC EVENT DATA can be left OFF if the sequencer START/PAUSE/STOP commands are not to be issued from the DX1.

(f) Call F16--SEQUENCE CONTROL to issue the sequencer commands. At this point the START command can be issued to begin playback.

(4) Controlling the DX1 From a Computer

A personal computer can be connected to the DX1 via a MIDI interface, and used to control the DX1 with sequencer-type software. In this case, data transfer is one-way: from the computer to the DX1 (fig. 103).

*Main Signal Contents

* Reception: BASIC EVENT DATA

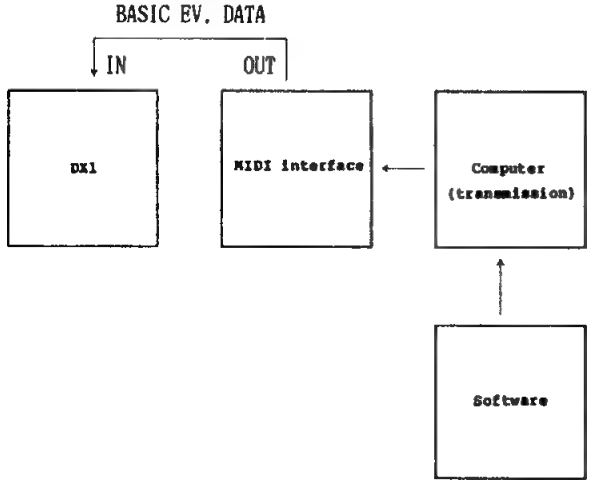
*Connection and Operating Procedure

* As with a sequencer, a number of MIDI channels are used to separately transmit the individual parts.

(a) Connect the MIDI interface to the computer, and connect the interface MIDI OUT terminal to the DX1 MIDI IN terminal.
* If it is desired to simultaneously control other instruments as well, connect as follows:
Interface MIDI OUT ⇨ Instrument 1 MIDI IN. Instrument 1 MIDI THRU ⇨ Instrument 2 MIDI IN, etc.

(b) Set the DX1 to the FUNCTION mode.
(c) Turn F15--MIDI SWITCH ON.
(d) Match the PERFORMANCE NUMBER channels to be used with those of the computer.
* When a single DX1 is being controlled, set the F15--OMNI MODE ON.
* If the transmisson channels for different parts of a piece are separated at the

Fig. 103. Computer-controlled Automatic Performance System



computer, an automated ensemble performance can be created by controlling a number of instruments all set to receive different "part" channels.
* If the OMNI MODE is ON and the F2--SOURCE SELECT is set to 0, the DX1 keyboard can be played during computer playback.

(e) Set the DX1 to the PLAY mode to prevent reception errors.

(f) Enter the playback command at the computer.
* The computer will not transmit OTHER EVENT DATA, so the voice selected at the DX1 will be played.
* If it is possible to use the DX1 SYSTEM REAL TIME DATA to control START, PAUSE and STOP of the computer (this depends on the computer and interface), connect the DX1 MIDI OUT terminal to the interface MIDI IN terminal, and while in the FUNCTION mode the F16--SEQUENCE CONTROL function can be used to issue the corresponding commands.

(5) Playing an External Instrument via the DX1

Another MIDI compatible instrument can be "remote controlled" from the DX1.

*Main Signal Contents

* Transmission: BASIC EVENT DATA, OTHER EVENT DATA

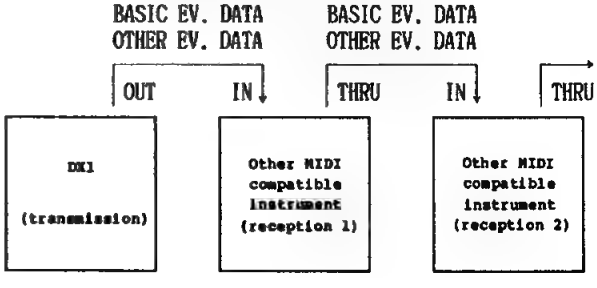
*Connection and Operating Procedure

(a) Connect the DX1 MIDI OUT terminal to the receiving instrument MIDI IN terminal.
* If it is desired to simultaneously control other instruments as well, connect as follows:
Transmitting keyboard MIDI OUT ⇨ Receiving Instrument 1 MIDI IN. Receiving Instrument 1 MIDI THRU ⇨ Receiving Instrument 2 MIDI IN, etc.

(b) Switch the DX1 to the FUNCTION mode, and set F15 MIDI SWITCH ON.
(c) Turn the F15--SET STATUS--BASIC EVENT DATA and OTHER EVENT DATA ON, permitting transmission of BASIC EVENT DATA and OTHER EVENT DATA from the DX1.
* Match the reception channel of the receiving instrument with the transmission channel of the DX1.
* The F2--SOURCE SELECT function sets the DX1 reception channel. The transmission channel is fixed at channel 1.

(d) Set the F15--SET STATUS--PROGRAM CHANGE MODE according to whether VOICE MEMORY or

Fig. 104. Control of Other MIDI Compatible Instruments via the DX1



PERFORMANCE MEMORY switching is to be performed.
* If the receiving instrument is not a DX1, PROGRAM CHANGE MODE must be set to VOICE.

(e) Set the DX1 to the PLAY mode to prevent data errors.

(f) At this point, the receiving keyboard can be played from the DX1.
* The voice in the receiving keyboard selected by the transmitting keyboard PEOGRAM CHANGE function is played.
* If the receiving instrument is a DX1, DX7 or DX9, turn the F15--SET STATUS--SYSTEM EXCLU. COMMUNICATION mode ON, permitting editing of receiving instrument voice data from the transmitting DX1.

(6) Mutual Real-Time Control Between The DX1 and Another DX Series Keyboard

This system permits the DX1 and another DX series keyboard to be connected, and either keyboard can be controlled from the other. Transferrable data includes not only real-time performance data, but voice and performance memory parameter as well (fig. 105).

*Main Signal Contents

* Transmission: BASIC EVENT DATA, OTHER EVENT DATA, SYSTEM EXCLUSIVE DATA
* Reception: BASIC EVENT DATA, OTHER EVENT DATA, SYSTEM EXCLUSIVE DATA

*Connection and Operating Procedure.

(a) Connect the MIDI OUT terminal of keybaord 1 to the MIDI IN terminal of keyboard 2, and connect the MIDI OUT terminal of keyboard 2 to the MIDI IN terminal of keyboard 1.

(b) Swith to the FUNCTION mode and turn F15--MIDI SWITCH ON.
* If the other keyboard also has this function, perform the same operation on it.

(c) Using F15--SET STATUS, turn BASIC EVENT DATA OUTPUT, OTHER EVENT DATA OUTPUT and SYSTEM ECLU. COMMUNICATION ON.
* Perform the same operations on the other keyboard.

(d) To transfer voice or effect data between the keyboards, set the transmitting keyboard to the PLAY mode, then select the desired VOICE MEMORY or PERFORMANCE MEMORY while holding the DATA ENTRY YES button.
* The transmitted voice or effect data will be read into the corresponding VOICE EDIT BUFFER or PERFORMANCE EDIT BUFFER of the receiving keyboard.
* Effect data can only be received by another DX1.
* When INITIALIZE VOICE has been performed, the initialized voice data can be transmitted (It is not necessary to press DATA ENTRY YES). When the RECALL EDIT BUFFER function is performed, the data recalled from the VOICE EDIT BUFFER UTILITY can be transmitted (It is not necessary to press DATA ENTRY YES).
* To play a voice contained in the receiving instrument voice memory, select the voice or performance memory number without pressing the YES button. In this case, voice data in the VOICE EDIT BUFFER which was transferred from the transmitting instrument will be lost.

(e) To edit data, set the transmitting instrument to the EDIT mode, select the parameter to be edited and perform the edit process.
* The EDIT data is placed in the VOICE EDIT BUFFER.

(f) To edit performance data, switch the transmitting instrument to the FUNCTION mode, select the parameter to be edited and perform the edit process.
* Effect data can only be edited if the transmitting and receiving instruments are both DX1s.
* Only performance memory parameters can be transferred. MEMORY MANAGEMENT and MIDI INFO control data can not be altered (except for F15--OMNI MODE).
* A STORE operation must be performed to save data received via MIDI. Data transfer can not be accomplished in the STORE mode.

(7) Memory Data Transfer Between a DX1 and Another DX Series Keyboard

All voice memory data can be transferred between a DX1 and another DX1, DX7 or DX9. Performance memory data can be transfered between two DX1s.

Fig.105. Bi-diectional Real-time Control with 2 DX Units

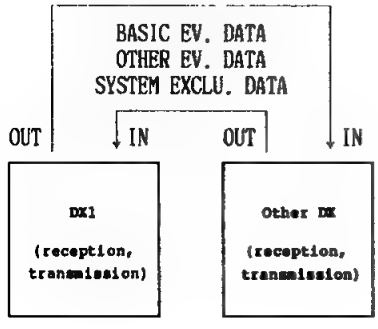
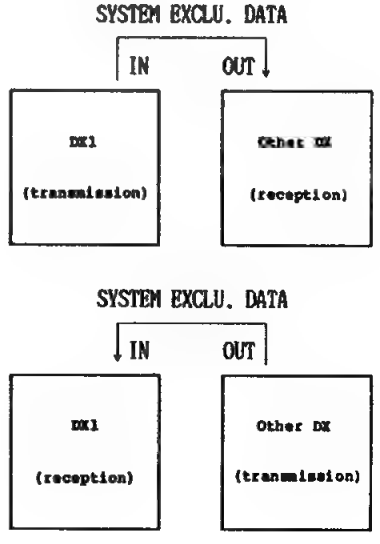


Fig.106. Memory Data Transmission with 2 DX Units



*Main Signal Contents

* Transmission: SYSTEM EXCLUSIVE DATA
* Reception: SYSTEM EXCLUSIVE DATA

* Connection and Operating Procedure (DX1 to other keyboard)

(a) Connect the MIDI OUT terminal of the DX1 to the MIDI IN terminal of the second keyboard.
* To transfer data from the second DX keyboard to the DX1, connect the MIDI OUT terminal of the second keyboard to the MIDI IN terminal of the DX1.
(b) Switch to the FUNCTION mode.
* If the DX1 is the receiving instrument, set any mode but STORE.
(c) Turn F15--MIDI SWITCH ON.
* Perform the same operation on the second keyboard.
(d) Using F15--SET STATUS, turn SYSTEM EXCLU. COMMUNICATION ON.
* Perform the same operation on the second keyboard.
(e) Turn the memory protect function of the receiving keyboard OFF.
* Memory protect is turned OFF using F14--PROTECT MEMORY WRITE.
(f) Using F15--TRANSMIT DATA, select the data to be transmitted, and begin the transmission.
* The DUMP ALL VOICE IN BANK A, B function sends all voice data, and the DUMP ALL PERFORMANCE function sends all performance data.
* The received data is loaded directly into the respective VOICE or PERFORMANCE MEMORY.
* Reception is not possible if the receiving instrument is set to the STORE mode.
* If the DX1 receives data in the FUNCTION mode, the lower row of the display will read "MIDI Received bulk data through MIDI".
* If the DX1 receives data in the PLAY or EDIT modes, the upper row of the display will read "<<MIDI>>".

CHAPTER 9

FM TONE GENERATOR THEORY

9-1 Approaching the FM Tone Generator

The basic signal source used in the FM tone generator (the operator) produces a pure sine wave with absolutely no harmonics. By applying FM modulation to this sine wave a complex harmonic spectrum can be produced. To get the most from this sophisticated system however, it is necessary for the musician or programmer to be able to "forecast" the approximate results of certain operation in order to be able to program a specific sound.

FM Tone Generator Parameters

As described in Chapter 1, the FM tone generator produces voices according to the frequency ratio between the modulators and carriers, modulator level, feedback, and the configuration of the algorithm used.

* Modulator/Carrier Frequency Ratio (Harmonic Spectrum)

The frequency ratio between modulators and carriers is the most important element in voice programming. It determines the harmonic spectrum, waveform, and the basic sound. For example, if the carrier/modultor frequency ratio is set at 1:1, the result is all integer harmonics, producing a triangle waveform. If 1:2, a square waveform incorporating all odd harmonics is produced. A 1:3 ration results in a rectangular waveform with integer harmonics minus multiples of 3.

* The modulator/carrier frequency ratio is set using the OSCILLATOR block COARSE and FINE parameters.

Modulator Level: FM Depth

When modulator level is set to 0, FM modulation is OFF. The carrier will produce an unmodulated sine wave. As the modulator level is increased, so does the depth of modulation and thus the number of harmonics. Generally, increasing the modulation level increases the brightness of the sound.

* Modulation level is set with the OPERATOR OUTPUT LEVEL parameter.

* Feedback

Feedback permits a carrier or modulator to modulate itself. When feedback is set to 0 no self-modulation is applied. As with modulator level, increasing feedback results in an increase in harmonic content and an increase in the brightness of the sound.

* Feedback level is set with the ALGORITHM block FEEDBACK parameter.

* Algorithm: Operator Configuration

The algorithm most suited to the target sound should be selected from the 32 configurations provided, and then the modulator/carrier frequency ratio, modulation level and feedback level data set. The resultant voice will vary greatly according to the algorithm selected. In general, algorithms with a large number of vertically arranged modulators create "harder" voices, while algorithms with a larger number of horizontally aligned carriers produce softer, deeper timbres.

* The algorithm is selected using the ALGORITHM parameter.

The Modulator/Carrier Frequency Ratio and Harmonic Spectrum

The relationship between modulator/carrier frequency ratio is basically described in the following formula, where C is the carrier after modulation, fc is the carrier frequency before modulation, fm is the modulator frequency, and n is an integer including 0 (0, 1, 2, 3, 4, ...).

$$C = |fc \pm n\,fm|$$
$$= |fc-fm| + |fc+fm| + |fc-2\,fm| + |fc+2\,fm| + |fc-3\,fm| + |fc+3\,fm| \cdots\cdots \quad \textit{formula 1}$$

* This formula is not precise, but it is perhaps the easiest to understand.

* Let's see if by setting the modulator/carrier pitch ratio to 1:1 (fm=fc) we get a waveform cotaining all integer harmonics (triangle wave).

$$C = fc + 2\,fc + 3\,fc + 4\,fc + \cdots\cdots \quad \textit{formula 2}$$

There it is, the integer harmonics are all there. Figure 8 is an example of this type of waveform (modulator level = 85).

* Normally, this type of waveform is used as a basis for brass instrument or string instrument voices.

* Next, we'll set the modulator/carrier ratio to 1:2 (fm=2fc).

$$C = fc + 3\,fc + 5\,fc + 7\,fc + \cdots\cdots \quad \textit{formula 3}$$

The harmonics are all odd, and we get a square waveform. Figure 9 is an example of this type of waveform (modulator level = 85).

* This type of waveform is normally used for woodwind voices.

* This time we'll try a ratio of 1:3 (fm=3fc).

$$C = fc + 2\,fc + 4\,fc + 5\,fc + \cdots\cdots \quad \textit{formula 4}$$

The result is integer harmonics, except for multiples of 3, producing a rectangular (pulse) waveform. Figure 10 is an example of this type of waveform (modulator level = 85).

* This type of waveform is often used for wind and string instrument voices.
* If the modulator/carrier pitch ratio is set to 1:n, a non-symmetrical rectangular waveform with a 1:n duty cycle is produced.

* Now, let's try a ratio of 1:3.33 (fm=3.33fc)--a "fractional" ratio.

$C = fc + 2.33fc + 4.33fc + 5.66fc + 7.66fc + \cdots$ ——— *formula 5*

The harmonics are all fractions. This is one of the strongest points of the FM tone generator system. Virtually any harmonic spectrum can be produced. Figure 11 is an example of this type of waveform (modulator level = 85).

Fig. 107. Waveform Variation with Relative Pitch 1.
fm=fc (m. level=85)

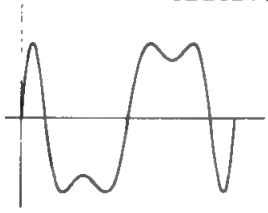


Fig. 108. Waveform Variation with Relative Pitch 2
fm=2fc (m. level=85)

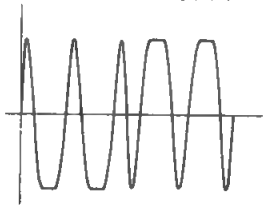


Fig. 109. Waveform Variation with Relative Pitch 3.
fm=3fc (m. level=85)

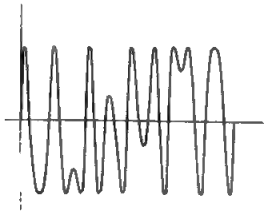
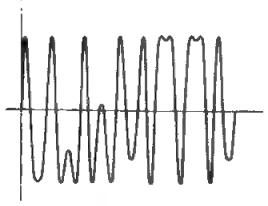


Fig. 110. Waveform Variation with Relative Pitch 4.
fm=3.33fc (m. level=85)



* By using a small fractional ratio like this, a large number of low-frequency harmonics are generated, resulting in metallic sound of indefinite pitch. The 1;3.33 ratio, for example, is ideal for generating bell sounds.

* Now let's try stacking two modulators, the top modulator modulating the second, then use the output from the lower modulator to modulate a carrier (fig. 12). If we set the pitch ratio between M1 and M2 at 1:1, the output from M2 will be:

$M_2 = fm + 2fm + 3fm + 4fm + \cdots$ ——— *formula 6*

Fig. 111. Modulator Second Level Algorithm (stacked vertically)

* If the ratio between M2 and C is also set at 1:1, we still end up with all integer harmonics, but the level of the harmonics will be higher resulting in a brighter timbre.
* If the ratio between the M2 modulator and carrier frequencies is shifted just slightly, a uniform but random harmonic spectrum will be produced throughout the frequency range, producing a white-noise type sound.

Waveform Variation Due to Modulator Level

* While carrier level determines the volume of the sound, modulator level determines the strength of the modulation, and thus the level of the harmonics produced. Formula 7, below, describes the effect of modulation level. C is the actual output after modulation, fc is the fundamental frequency of the carrier before modulation, f2--fn are the harmonics, and Am is the modulation level (0<=AM<=99, 99 IS MAXIMUM operator output level).

$C = fc + Am/99\ (f_2 + f_3 + f_4 + \cdots + f_n)$ — *formula 7*

* This formula is not precise, but it clearly demonstrates the way the level of the harmonics increase with increased modulation level.
* Figures 13--17 show how the output waveform changes as modulator level is increased with a modulator/carrier ratio of 1:1. The waveform increases in complexity as the modulator level is increased.
* A modulator level between 70--90 is generally fine to produce basic triangular or rectangular waveforms.
* For fractional frequency ratios, the pitch of the resultant sound becomes less defined as modulator level is increased.

Harmonic Spectrum Variation Due to Feedback

Using feedback, an operator can be made to modulate itself with its own output (fig. 18). In other words, a single operator can function as a modulator and as a carrier at the same time. Of course, the modulation frequency ratio is always 1:1.

* In the 32 algorithms available in the DX1, some permit application of feedback

to a carrier while some permit application of feedback to a modulator. Whether applied to a modulator or carrier, the result is equivalent to an infinite stack of modulators all set to a 1:1 frequency ratio (fig. 111).

Fig. 112. Waveform Variation with Modulator Level 1.

m. level=0
(Sine wave fm=fc)

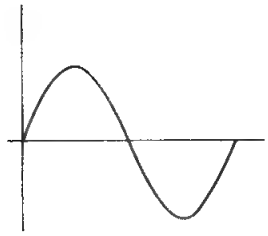


Fig. 113. Waveform Variation with Modulator Level 2.

m. level=65 (fm=fc)

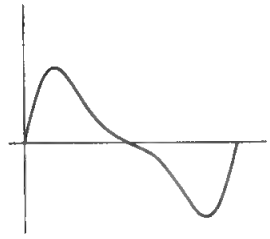


Fig. 114. Waveform Variation with Modulator Level 3.

m. level =75 (fm=fc)

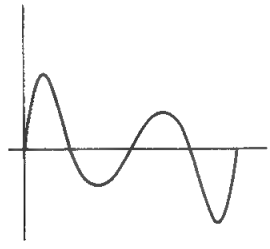


Fig. 115. Waveform Variation with Modulator Level 4.

m. level=85 (fm=fc)

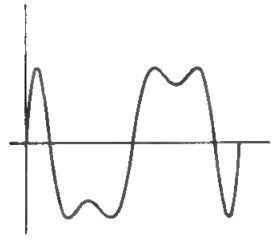


Fig. 116. Waveform Variation with Modulator Level 5.

m. level=99 (fm=fc)

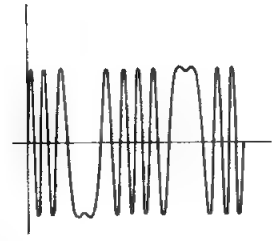
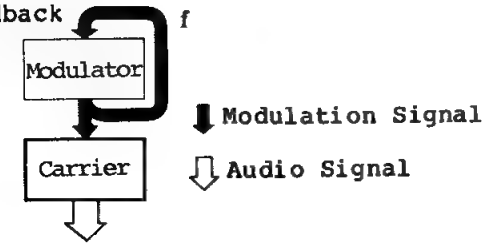


Fig. 117. Feedback



Algorithm Selection

Basically, any algorithm can be used for voice programming, but some are more suited to the creation of certain types of voices than others. The 32 available algorithm configurations are printed to the left of the DX1 LED display. They can be broadly categorized by the number of carriers they use.

* 1 or 2 Carriers (ALGORITHM 1--4, 7--18)

With only 1 or 2 carriers, and the rest of the operators function as modulators, the hardest, brightest voices can be produced, and the greates timbre variation based on the EG curve is possible. This type of configuration is also the easiest to create "noise" voices with. Generally, this is the best for solo instrument voices. Lower modulator level settings make it possible to create piano-like waveforms.

* 3 Carriers (ALGORITHM 5, 6, 19, 20, 26--28)

With 3 carriers, it is possible to program each to produce a "portion" of the target voice, and then mix them in the right proportin to create the finished voice. It is also possible to detune the pitch of the carriers for a chorus effect. Since 3 modulators are also available, extremely fine control is possible. Basically, this configuration makes it the easiest to predict the outcome, and offers the broadest voice creation possibilities.

* 4--6 Carriers (ALGORITHM 21--25, 29--32)

A larger number of carriers and fewer modulators makes it possible to create particularly full, rich voices. If feedback is applied, however, hard, brittle voices can also be produced. Extremely thich chorus effects can be produced by detuning the pitch of all the carriers. This is ideal for creating organ coupler effects.

9-2 FM Tone Generator Theory

In this section we'll describe the theoretical aspects of FM tone generation, using the appropriate formulae.

Sine Wave Memory

* The FM tone generators consist of a sine wave memory (SWM). The sine wave memory receives digital pitch data as input, and outputs a sine wave of the corresponding pitch, formed of a number of digital values stored in memory (fig. 118).
* For example, if input 0 is gived, then the output of the SWM, y , is

$$y = \sin\theta, \quad (0 \leq \theta < 2\pi) \qquad \text{formula 8}$$

Fig. 118. Sine Wave Memory

* To produce a time based variation, let us assume that 0 varies linearly 0 = wt (fig. 119a), w is the angular velocity, and t is time, this gives:

$y = \sin\omega t$ (fig. 119b) ——— *formula 9*

The output of the sine wave memory is a pure sine wave.

Basic FM Tone Generator Formulae

If the speed of 0 is then doubled 0 = 2 wt (fig 120a), then:

$y = \sin 2\omega t$ ——— *formula 10*

Note that the waveform produced by formula 10 has twice the frequency of that produced by formula 9.

* Now if 0 varies as a sine wave rather than linearly (0 = wt + sin wt: fig. 121a) we get (formula 11, fig 121b):

$y = \sin(\omega t + \sin\omega t)$ ——— *formula 11*

The result is a waveform quite different from the original. If the input to the operator varies--such as a sine wave-the result is that we are applying frequency modulation (FM) to the operator. In formula 11, y = sin wt is an operator used as a carrier and modulator, to which FM is applied.

* Now, what happens if the modulator frequency is doubled (0 = wt + sin 2 wt):

$y = \sin(\omega t + \sin 2\omega t)$ ——— *formula 12*

A completely different waveform is produced. If the angular velocity of the modulator is varied in relation to the carrier, a broad range of waveforms can be produced.

* Taking formula 11 and 12 into account, we can create a formula which defines all FM modulation:

$y = \sin(\omega c\, t + \sin\omega m\, t)$ ——— *formula 13*

wc is the carrier angular velocity, and wm is modulator angular velocity.

* In the DX1, however, it is the pitch ratio between the modulator and carrier that is controlled, not angular velocity. wc is expressed in terms of carrier pitch as (wc = 2 pi fc), and wm is expressed in terms of modulator pitch as (wm = 2 pi fm):

$y = \sin(2\pi fct + \sin 2\pi fmt)$ ——— *formula 14*

* The formula is still not complete. Formula 14 represents the modulator and carrier as both having level 1. In fact, carrier level is used to control volume, while modulator level is used to control timbre, so these two elements must be added. Carrier level will be expressed as Ac, and modulator level will be expressed as Am:

$y = Ac \sin(2\pi fct + Am \sin 2\pi fmt)$ ——— *formula 15*

This is the basic FM tone generator formula. It permits representation of 1 modulator and 1 carrier in an FM tone generator system.

How the FM Tone Generator Produces Rich Harmonic Structures

Fig. 119. $y = \sin\omega t$

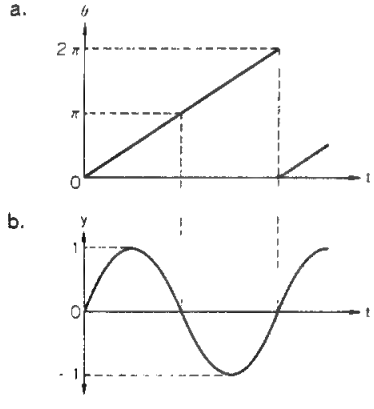


Fig. 120. $y = \sin 2\omega t$

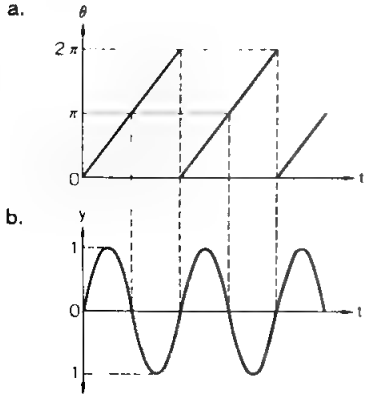


Fig. 121. $y = \sin(\omega t + \sin\omega t)$

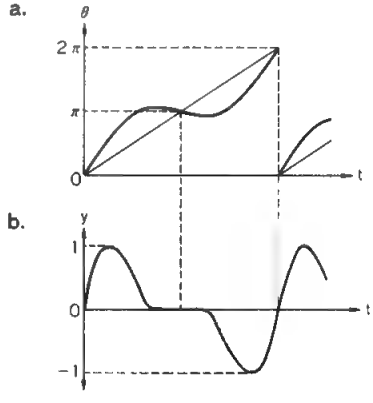
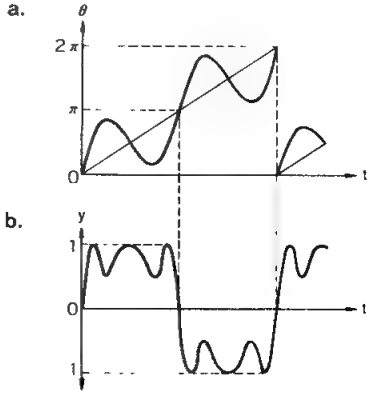


Fig. 121. $y = \sin(\omega t + \sin 2\omega t)$



* Let's look at how the FM tone generator can produce complex harmonic structures in terms of the formula. Using the formula sin (A + B) = sin A cos B + cos A sin B, we'll modify formula 15:

$$y = Ac \{ \sin 2\pi fct \ \underline{\cos (Am \sin 2\pi fmt)} + \cos 2\pi fct \ \underline{\sin (Am \sin 2\pi fmt)} \} \quad \text{formula 16}$$

* Then if we use the Bessel function to modify the underlined portions of formula 16, we get formula 17. The Bessel function Jn becomes the modulator level function J (Am).

$$y = Ac \{ J_0 \sin 2\pi fct + 2J_1 \cos 2\pi fct \sin (1 \cdot 2\pi fmt) + 2J_2 \sin 2\pi fct \cos (2 \cdot 2\pi fmt) + 2J_3 \cos 2\pi fct \sin (3 \cdot 2\pi fmt) + 2J_4 \sin 2\pi fct \cos (4 \cdot 2\pi fmt) + \cdots \} \quad \text{formula 17}$$

* We then use the triangular function
2 cos A sin B = sin (A + B) - sin (A - B)
2 sin A sin B = sin (A + B) + sin (A - B)
to modify formula 17 further:

$$y = Ac \{ J_0 \sin 2\pi fct + J_1 \{ \sin 2\pi \underline{(fc+fm)} t - \sin 2\pi \underline{(fc-fm)} t \} + J_2 \{ \sin 2\pi \underline{(fc+2fm)} t - \sin 2\pi \underline{(fc-2fm)} t \} + J_3 \{ \sin 2\pi \underline{(fc+3fm)} t - \sin 2\pi \underline{(fc-3fm)} t \} + J_4 \{ \sin 2\pi \underline{(fc+4fm)} t - \sin 2\pi \underline{(fc-4fm)} t \} + \cdots \} \quad \text{formula 18}$$

Now things get easier. Look at the underlined portions of formula 18. In addition to the original carrier frequency fc, we now have an infinite string of harmonics |fc + fm|, |fc - fm|, |fc + 2 fm|, |fc - 2 fm|, etc.

* It is clear that the frequency of the hamonics is determined by the frequency of the modulator (fm) and that of the carrier (fc).
* The level of each harmonic is determined by the Bessel function Jn, but actually the Bessel function value is the modulator level function Am. The modulator level (Am) determines the level of the harmonics, and therefore the brightness of the sound.

* Let's tke a look at the harmonic spectrum produced by a modulator/carrier pitch ratio of 1:1 (fc = fm).

$$y = Ac \{ (J_0 - J_2) \sin (\underline{1} \cdot 2\pi fct) + (J_1 + J_3) \sin (\underline{2} \cdot 2\pi fct) + (J_2 - J_4) \sin (\underline{3} \cdot 2\pi fct) + (J_3 + J_5) \sin (\underline{4} \cdot 2\pi fct) + \cdots \} \quad \text{formula 19}$$

Looking at the underlined portions of forumula 19, we can see that all the integer harmonics are included. Such all-integer harmonic structure results in a triangular waveform.

* Next, the modulator/carrier pitch ratio is 1:2 (2fc = fm):

$$y = Ac \{ (J_0 + J_1) \sin (\underline{1} \cdot 2\pi fct) + (J_1 - J_2) \sin (\underline{3} \cdot 2\pi fct) + (J_2 + J_3) \sin (\underline{5} \cdot 2\pi fct) + (J_3 + J_4) \sin (\underline{7} \cdot 2\pi fct) + \cdots \} \quad \text{formula 20}$$

Obviously, we have all odd-numbered harmonics, producing a square wave.

* Now let's try a ratio of 1:3 (3fc = fm):

$$y = Ac \{ (J_0 + J_1) \sin (\underline{1} \cdot 2\pi fct) + (J_1 - J_2) \sin (\underline{2} \cdot 2\pi fct) + (J_2 + J_3) \sin (\underline{4} \cdot 2\pi fct) + (J_3 + J_4) \sin (\underline{5} \cdot 2\pi fct) + \cdots \} \quad \text{formula 21}$$

Clearly, we have all integer harmonics except those numbers which are multiples of 3. This is a rectangular waveform with a 1:3 duty cycle.

* As we have seen, it is also possible to set up a non-integer frequency ratio, such as 1:3.33. In this case |fc + fm| = 4.33, |fc - fm| = 2.33, |fc + 2fm| = 7.66, |fc - 2fm| = 5.66, etc. The result is a complex, random harmonic spectrum.

$$y = Ac \{ (J_0 + J_1) \sin (\underline{1.00} \cdot 2\pi fct) + (J_1 - J_2) \sin (\underline{2.33} \cdot 2\pi fct) + (J_2 + J_3) \sin (\underline{4.33} \cdot 2\pi fct) + (J_3 + J_4) \sin (\underline{5.66} \cdot 2\pi fct) + \cdots \} \quad \text{formula 22}$$

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CHAPTER 10

GENERAL SPECIFICATIONS

◆Keyboard
◇73KEY E0 ~E6 (Wooden weighted keyboard)
◇TOUCH CONTROL : KEY VELOCITY, AFTER TOUCH
◆Sound Source
◇FM TONE GENARATOR (6 OPERATOR×A-B)
◆Simultaneous Note Output
◇POLYPHONIC : SINGLE 32/DUAL 16/SPLIT 16+16
◇MONOPHONIC : SINGLE 1/DUAL 1/SPLIT 1+1
◆Internal Voice Memory
◇VOICE MEMORY : 4 BANK×8 VOICE ×A-B
◇PERFORMANCE MEMORY : 8 BANK×8 PERFORMANCE
◆Controls
◇VOLUME : VOLUME SLIDER, BALANCE SLIDER, PHONES VOLUME
◇EFFECT CONTROLLER : PORTAMENTO TIME SLIDER, PITCH BEND WHEEL, MODULATION WHEEL
◇DATA ENTRY : DATA ENTRY SLIDER, +/- SW,
◇MEMORY&PARAMETER SELECT : EDIT PARAMETER (ALGORITHM, OPERATOR), VOICE MEMORY, PERFORMANCE MEMORY/FUNCTION, CARTRIDGE A-B
◇KEY ASSIGN MODE : SINGLE, DUAL, SPLIT
◇MODE SELECTOR : EDIT/COMPARE, FUNCTION, STORE
◇OTHER : OPERATOR SELECT, OPERATOR ON/OFF, DISPLAY SELECT (EG/PITCH EG)
◆Display
◇LED GRAPHIC DISPLAY : EDIT PARAMETER=ALGORITHM, OPERATOR
◇LC DISPLAY : EDIT PARAMETER=LFO etc /FUNCTION PARAMETER
◆Connection Terminals/Interface
◇AUDIO OUTPUT : OUTPUT A-B-P (PHONE JACK, XLR TYPE balanced), PHONES (STEREO PHONE JACK 8~150 Ω)
◇CONTROL JACK : MODULATION, VOLUME, SUSTAIN ON/OFF, PORTAMENTO ON/OFF
◇INTERFACE : MIDI IN-OUT-THRU, CARTRIDGE INSERT A-B
◆Edit Parameters
◆ALGORITHM
◇ALGORITHM, FEEDBACK
◆OPERATOR
◇OSCILLATOR : MODE, DETUNE, COARSE, FINE
◇ENVELOPE GENERATOR : EG (R1~R4, L1~L4), PITCH EG (R1~R4, L1~L4)
◇KEYBOARD SCALING : LEVEL SCALING (LEFT DEPTH, LEFT CURVE, BREAK POINT, RIGHT CURVE, RIGHT DEPTH), RATE SCALING
◇SENSITIVITY : KEY VELOCITY, AMPL, MODULATION
◇OPERATOR OUTPUT LEVEL
◆LFO
◇WAVE, SPEED, DELAY, PMD, PMS, AMD, KEY SYNC
◆OTHER
◇OSCILLTOR KEY SYNC, TRANSPOSE, VOICE NAME
◆Function Parameters
◆MASTER TUNE
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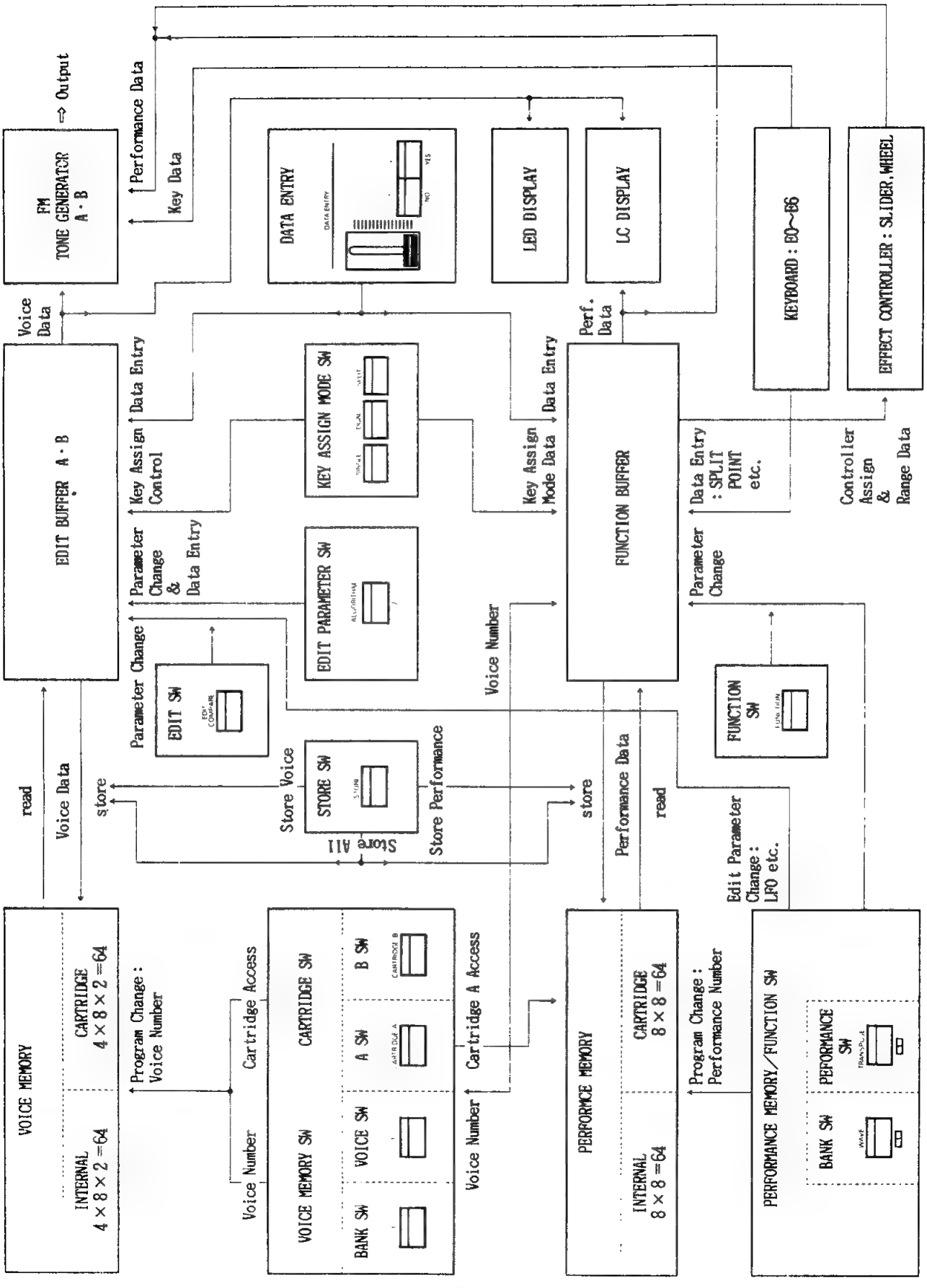
◇F1 : DUAL MODE DETUNE
◇F2 : POLY/MONO, SOURCE SELECT
◇F3 : PITCH BEND (RANGE, STEP)
◇F4 : PORTAMENTO (PORTAMENTO/GLISSANDO, RETAIN/FOLLOW, PEDAL ASSIGN, TIME)
◇F5 : OUTPUT LEVEL ATTENUATE, PROG, OUT ASSIGN, SUSTAIN PEDAL ASSIGN
◇F6 : MOD, WHEEL (SENSITIVITY, ASSIGN), FOOT CONT. (SENSITIVITY, ASSIGN)
◇F7 : BRTH CONT, (SENSITIVITY, ASSIGN), AFTER TOUCH (SENSITIVITY, ASSIGN)
◇F8 : SPLIT POINT, KEY SHIFT, PERFORMANCE NAME
◆PERFORMANCE MEMORY PARAMETER/KEY INDIVIDUAL AFTER TOUCH
◇F9 : TOTAL SENSITIVITY, DECAY RATE, RELEASE RATE
◇F10 : OP 1 DEPTH, OP 2 DEPTH, OP 3 DEPTH
◇F11 : OP 4 DEPTH, OP 5 DEPTH, OP 6 DEPTH
◆MEMORY MANAGEMENT
◇F12 : COPY OP DATA (ENVELOPE DATA, OSCILLATOR DATA), SAVE TEMP OPERATOR, INITIALIZE MEMORY (INITIALIZE VOICE, INITIALIZE PERFORMANCE), RECALL EDIT BUFF
◇F13 : SAVE TO CARTRIDGE (ALL VOICE A, ALL VOICE B, ALL PERFORMANCE), LOAD FROM CARTRIDGE (ALL VOICE A, ALL VOICE B, ALL PERFORMANCE), CHANGE CART FORMAT
◇F14 : PROTECT MEMORY WRITE, CLEAR ALL MEMORY, CHECK BATTERY
◆MIDI INFORMATION CONTROL
◇F15 : MIDI SWITCH, SET STATUS (BASIC EVENT DATA OUTPUT, OTHER EVENT DATA OUTPUT, SYSTEM EXCLU, COMMUNICATION, OMNI MODE, PROGRAM CHANGE MODE), TRANSMIT DATA (DUMP ALL VOICE IN A, DUMP ALL VOICE IN B, DUMP ALL PERFORMANCE)
◇F16 : REMOTE SEQUENCE
◆Finish
◇Side Panelling: Brazilian Rose
◇Control Panel: Light Metallic Brown
◆Dimensions/Weight
◇Dimensions : 1255W× 225H× 640D mm (55" x 9" x 25")
◇Weight : 51kg (112.2 lbs)
◆Power=100V
◆POWER REQUIREMENTS
U.S. & Canadian Models: 120V, 60Hz
General Models: 110--120/220--240V, 50/60Hz
◆Supplied Accessories
◇FOOT SW FC-4×2
◇FOOT CONTROLLER FC-3A ×2
◇BREATH CONTROLLER BC-1×1
◇MUSIC STAND
◇POWER CABLE
◇ROM VOICE MEMORY CARTRIDGE× 4
◇ROM PERFORMANCE MEMORY CARTRIDGE× 1
◇RAM 1 DATA CARTRIDGE x 3 (for U.S. Models only)
※Specifications subject to change without notice.

BLOCK DIAGRAM



YAMAHA DX7 DIGITAL PROGRAMMABLE ALGORITHM SYNTHESIZER

VOICE LIBRARY
with
PERFORMANCE NOTES

PERFORMANCES & VOICES

I. BRASS GROUP

No.	Performance Name	Voice Name A	Voice Name B	Performance Note
1–1	Double Horn Section (Detuned)	Horn Sec. A	Horn Sec. B	Vary brilliance with velocity of touch and after touch.
1–2	Fanfare Trumpets	Trumpet A	Trumpet B	Vary brilliance and volume with attack. Add vibrato with Mod. Wheel.
1–3	Full Synth Brass (Detuned)	Syn Brs 1A	Syn Brs 1B	Vary brilliance with attack. Use after touch to add brilliance and vibrato.
1–4	Tight Brass Section	Tight Br. A	Tight Br. B	Brass in octaves. Add Mod. Wheel for vibrato. Play full chords for section effect.
1–5	Synth Brass [After Touch]	Syn Brs 2A	Syn Brs 2B	Use after touch for "filter sweep" effect.
1–6	Synth Brass [F/C Chorus]	Syn Brs 3A	Syn Brs 3B	Plug in FC-3A foot controller to MODULATION jack on rear panel, and use it for chorus-like effect. Mod. wheel can be used for same effect.
1–7	CS80 Brass [F/C Vibrato]	CS80 Brs A	CS80 Brs B	Use FC-3A or Mod. wheel for vibrato.
1–8	Strings & Brass Ensemble [A/T]	Bright St.	Brass	Complex sound. Use after touch to vary volume.

II. STRINGS GROUP

No.	Performance Name	Voice Name A	Voice Name B	Performance Note
2–1	Cello Quartet	Cellos 1A	Cellos B	Vary "bowing" with speed of attack. Add vibrato with after touch and Mod. Wheel. Transpose up or down a fifth with Pitch Wheel.
2–2	Violin Ensemble	Violins A	Violins 1B	Vary "bowing" with attack. Add vibrato with after touch and Mod. Wheel. Use Pitch Wheel up or down to transpose one side up a fifth.
2–3	Ensemble [L]/Solo Violin [R]	St. Ens. 1A	Soloviolin	Split at G above middle C. Use portamento slider for glide on solo violin. Articulate solo violin bowing with velocity of touch and add vibrato with after touch.
2–4	String Orchestra	Mid. Strg A	Mid. Strg B	Vary brilliance and vibrato with after touch. Additional vibrato via Mod. Wheel. Especially nice for full rich string sections in lower octaves.
2–5	High Strings (Analog Type)	An. Strg A	An. Strg B	Use after touch to bring out individual notes. Add vibrato with after touch and/or Mod. Wheel. Great for high single line strings.
2–6	Cellos & Violins	Cellos 2A	Violins 2B	Violins fade in at approx. middle C in octaves with cellos. Use after touch and Mod. Wheel for vibrato.
2–7	String Ensemble [F/C vibrato]	St. Ens. 2A	St. Ens. B	Use FC-3A or Mod. wheel for vibrato.
2–8	Strings & Velocity Trumpets	Strings A	Trumpet B	Bring in brass sections with attack/velocity of touch. Add vibrato via after touch and Mod. Wheel.

III. KEYBOARD & PERCUSSIVE GROUP

No.	Performance Name	Voice Name A	Voice Name B	Performance Note
3–1	Acoustic Grand Piano 1	Piano 1A	Piano 1B	Vary brilliance and volume with attack.
3–2	Acoustic Grand Piano 2	Piano 2A	Piano 2B	Vary brilliance and volume with attack.
3–3	Electric Grand Piano	Elec Grd A	Elec Grd B	Vary brilliance and volume with attack.
3–4	Electric Piano [M/W Tremolo]	E. Piano 1A	E. Piano 1B	Move Modulation Wheel to Max. for stereo vibrato.
3–5	Electric Piano (Bright Tine)	E. Piano 2A	E. Piano 2B	Vary brilliance with attack. Add Mod. Wheel for slight chorus effect.
3–6	Dirty Electric Piano	E. Piano 3A	E. Piano 3B	Vary attack for "over-driven tine" attack. Add Mod. Wheel for stereo vibrato effect.
3–7	Clav. Ensemble	Clav. A	Clav. 1B	Vary brilliance and volume with attack. Add Mod. Wheel for vibrato.
3–8	Grand Harpsichord	Harpsi. 1A	Harpsi. B	Normal.
4–1	Pipe Organ [F/C Vibrato]	Pipes A	Pipes B	Use FC-3A or Mod. wheel for vibrato.
4–2	Jazz Organ [F/C Tremolo]	E. Organ 1A	E. Organ 1B	Use FC-3A or Mod. wheel for tremolo effect.
4–3	Rock Organ with Old Tone Cab	E. Organ 2A	E. Organ 2B	Vary attack for distortion. Add Mod. Wheel for slow rotating speaker effect.
4–4	E. Piano [L]/Jazz Guitar [R]	E. Piano 4A	Jazz Guitar	Split at middle C. Add vibrato to guitar via Mod. Wheel. Increase "plucking" of guitar with velocity touch.
4–5	Elec. Bass [L]/E. Piano [R]	Elec. Bass	E. Piano 4B	Split at Middle C. Pitch Bend Wheel is assigned to bass. "Slap bass strings" with velocity touch on left, increase dynamics of elec. piano with velocity touch on right.
4–6	Double Harps	Dbl. Harp A	Dbl. Harp B	Delayed stereo envelope effect. Increase "plucking" with velocity touch. Add vibrato via Mod. Wheel.
4–7	African Mallets	A. Mallet A	A. Mallet B	Vary brilliance and volume with attack. Use after touch to bring out odd harmonics.
4–8	Vibraphone	Vibes A	Vibes B	Vary "strike of mallet" with velocity touch. Add soft vibrato via Mod. Wheel. Use sustain pedal to suit taste.

IV. COMPLEX GROUP

No.	Performance Name	Voice Name A	Voice Name B	Performance Note
5–1	Electric Piano & Brass [BC1]	E.P. & Br A	E.P. & Br B	Plug in BC1 breath controller to jack on lower left front. Activate brass over the piano by blowing into BC1. Add vibrato to brass with after touch.
5–2	Electric Grand & Brass [BC1]	E. Grd & Br A	E. Grd & Br B	same as above.
5–3	Electric Piano & Sax [BC1]	E. Piano 5A	Sax [BC1]	same as above.
5–4	Elec. Piano & Clav Ensemble	E. Piano 6A	Clav. 2B	Vary volume and brilliance of Clav. with velocity of touch. Add vibrato with Mod. Wheel. Bring out additional harmonics with after touch.
5–5	Electric Piano & Strings	E. Piano 7A	Strings 1B	Add tremolo to piano and vibrato to strings with Mod. Wheel. Adjust balance slider to suit taste.
5–6	Harpsichord & String Ensemble	Harpsi. 2A	Strings 2B	Add vibrato to strings with Mod. Wheel. Adjust balance slider to suit taste.
5–7	Full Orchestra	Orchestra	Orch. Chime	Full chords in octaves work best. Use after touch for brilliance/"filter sweep" effect. Add vibrato to "orchestra" via Mod. Wheel. Fast staccato attack brings in bells.
5–8	Ride Cymbal & Fretless Bass	Fretles 1A	R. Cymbal	When notes are held, cymbal is "stopped". Quick attack/release of key lets cymbal "ring". Bass is in mono mode to allow for legato fingered portamento.

V. SPLIT GROUP

No.	Performance Name	Voice Name A	Voice Name B	Performance Note
6–1	Kick Drum [L] /Snare [R]	Kick Drum	Snare	Split at middle C. Increase dynamics with velocity touch.
6–2	Hi-Hat (Closing) [L] /Cymbal [R]	Cl. Hi-Hat	Cymbal	Split at middle C. Down keystroke "opens" hit-hat, release of key "closes". Cymbal is velocity sensitive. Hold key to "stop" cymbal, release of key allows cymbal to "ring".
6–3	Hand Claps [L] /Tom Toms [R]	Hand Claps	Tom Toms	Split at middle C. Play fast rolled group of notes left for "claps". Toms on right are velocitry sensitive.
6–4	Log Drums [L] /Roto Toms [R]	Log Drums	Roto Toms	Same as above.
6–5	Tombourine [L] /Timbali [R]	Tambourine	Timbali	Split at middle C. Play quick single notes left for tambourine. Timbalis on right are velocity sensitive.
6–6	Cowbell [L] /Wood Block [R]	Cowbell	Wood Block	Split E below middle C. Play single "hits" left and "selected" blocks right.
6–7	Fretless Bass [L] /Sax [BC1] [R]	Fretles 2A	Sax [BC1]	Split at A below middle C. Bass on left is mono for fingered portamento. Sax is controlled with the BC1 "mouthpiece" (Plug in on lower left front). Add vibrato to Sax via after touch.
6–8	Acoustic Piano [L] /Flute [R]	Piano 1A	Flute	Split at G above middle C. Piano is velocity sensitive. Add harmonics to Flute with after touch pressure.

VI. SYNTH GROUP

No.	Performance Name	Voice Name A	Voice Name B	Performance Note
7–1	Synthesizer Uprising	Syn-Rise A	Syn-Rise B	Hold full chord for best effect.
7–2	Sample & Hold [L] /Lead Line [R]	Sample & Hld	Lead Line	Split at F above middle C. Hold chord in left for sample/hold — play mono fingered portamento leadlines in right. Vary attack and after touch on leadline for modulation. Additional modulation and pitch bend on wheels.
7–3	Poly Synth [L] /Lead Synth [R]	Poly Synth	Lead Synth	Split at c above middle C to allow for chords in left hand. All other parameters same as above.
7–4	Percussive Synth [After Touch]	Perc. Syn. A	Perc. Syn. B	Very expressive by using velocity and after touch.
7–5	Toy Music Box	Music Bx A	Music Bx B	Normal
7–6	FM Ensemble	EM Ens. A	FM Ens. B	Vary brilliance with attack. Hold down a group of notes or hold sustain pedal for "ensemble" to fade in.
7–7	Planet of Ice	Plan. Ice A	Plan. Ice B	Hold chords for delayed envelopes to occur. Add vibrato via Mod. Wheel.
7–8	Male & Female Choir	F. Choir	M. Choir	Add vibrato with Mod. Wheel. Articulate voices with individual after touch. Adjust balance slider to suit taste.

VII. EFFECTS GROUP

No.	Performance Name	Voice Name A	Voice Name B	Performance Note
8–1	"Big Ben" [L]/Tuned Bells [R]	Big Ben	Tuned Bell	Split at G2.
8–2	Glass Wind Chimes	Glass WC A	Glass WC B	Arpeggiate several notes randomly. Note random stereo effect.
8–3	Jungle Noise (Growl/Birds)	Growl	Birds	Split at middle C. Lighty depress low key on left – push for "growl – Select random keys on right for "birds".
8–4	Side to Side	Two Four	One Three	Roll chords for random stereo effect. Add vibrato via Mod. Wheel. Try building up notes with sustain pedal depressed.
8–5	Traffic	Traffic A	Traffic B	Split at middle C. Left side for exhaust notes and horns, right side for whistles and another horns.
8–6	Floating Clouds	Fl. Cloud A	Fl. Cloud B	Pitch bend assigned to one side only. Try holding chords and slightly bending pitch for effects.
8–7	Combat (Explosion [L]/Guns [R]	Explosion	Machinegun	Hit any group of low keys for "bombs" – play random keys on right for "machine guns".
8–8	Bombs Away !!	Bomb Drop A	Bomb Drop B	Hold any group of keys and wait for "bombs" to explode.

FCC CERTIFICATION (USA)

While the following statements are provided to comply with FCC Regulations in the United States, the corrective measures listed below are applicable worldwide.

This series of Yamaha combo keyboards uses frequencies that appear in the radio frequency range and if installed in the immediate proximity of some types of audio or video devices (within three meters), interference may occur.
This series of Yamaha combo keyboards has been type tested and found to comply with the specifications set for a class B computing device in accordance with those specifications listed in subpart J of part 15 of the FCC rules. These rules are designed to provide a reasonable measure of protection against such interference. However, this does not guarantee that interference will not occur. If your combo keyboards should be suspected of causing interference with other electronic devices, verification can be made by turning your combo keyboards off and on. If the interference continues when your keyboard is off, the keyboard is not the source of interference. If your keyboard does appear to be the source of the interference, you should try to correct the situation by using one or more of the following measures:

Relocate either the keyboard or the electronic device that is being affected by the interference.

Utilize power outlets for the combo keyboard and the device being affected that are on different branch (circuit breaker or fuse) circuits, or install AC line filters.

In the case of radio or TV interference, relocate the antenna or, if the antenna leado-in is 300 ohm ribbon lead, change the lead to co-axial type cable.

If these corrective measures do not produce satisfactory results, please contact your franchised Yamaha combo keyboard dealer for suggestions and/or corrective measures. If you can not locate a franchised Yamaha combo keyboard dealer in your general area contact the Combo Service Department, Yamaha International, 6600 Orangethorpe Ave., Buena Park, CA 90620.

If for any reason, you should need additional information relating to radio or TV interference, you may find a booklet prepared by the Federal Communications Commission helpful: "How to Identify and Resolve Radio -- TV Interference Problems". This booklet is available from the U.S. Government Printing Office, Washington D.C. 20402--Stock

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